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A N
A C C O U N T
Of SOME
New Microscopical Discoveries

Founded on

An Examination of the CALAMARY, and its wonderful Milt-Vessels, (each of which tho' they exceed not an Horse-Hair in Diameter, contains a minute Apparatus analogous to that of a Pump, with a fine spiral Spring, Sucker, Barrel, &c.) tending to prove by an accurate Description of their Motion, Action, &c. that the hitherto supposed Animalcules in the Semen of Animals, are nothing more than Machines similar, tho' inconceivably less, to those discovered in this Sea-production.

A L S O,

Observations on the *Farina fecundans* of Plants; with a new Discovery and Description of the Action of those minute Bodies, analogous to that of the CALAMARY's Milt-Vessels.

And an Examination of the *Pistil*, *Uterus* and *Stamina* of several Flowers, with an Attempt to shew how the Seed is impregnated.

Likewise

Observations on the supposed *Embryo* SOLE-Fish fixed to the Bodies of *Shrimps*; with a new Discovery of a remarkable Animalcule found single on the Tail-part of each Embryo.

A Description of the *Eels* or *Worms* in blighted Wheat; and other curious Particulars relating to the Natural History of Animals, Plants, &c.

Dedicated to the ROYAL SOCIETY.

L O N D O N :

Printed for F. NEEDHAM, over-against Grey's-Inn in
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ERRATA.

PAge 17, line 2, after *few* dele the comma. Page 18, line 17, for *Excrefence* read *Excrefence*. Page 43, line 6, for *opening*, read *opened*. Page 45, line 15, for *Phænomena's* read *Phænomena*. Page 45, line 19, for *oblige* read *obliged*. Page 48, line 7, for *Piston* read *Sucker*. Page 50, line 9, for *in* read *into*. Page 71, line 17, for *extruded* read *exfuded*. Page 83, line 1, dele *o-ther*. Pag. 107, line 21, for *obers* read *others*.

The Reader is desired to correct these Errors with his Pen, before he reads the Book, as the Correction of some is of Consequence.





T O
MARTIN FOLKES, *Esq;*
T H E
Worthy President and Fellows
O F T H E
R O Y A L S O C I E T Y
O F
L O N D O N,

These Microscopical DISCOVERIES are
most humbly presented
by the AUTHOR.

T. N



T H E
P R E F A C E.

*I*T is not material to the Learned World to be informed, that when the Subjects, which are contained in this Essay, were under Examination, the Author was much indisposed, tho' it may be so to himself by way of Apology to his Readers for any Mistakes that may appear in the Course of this Performance. He wishes therefore with all his Heart, that they had fallen in the Way of a more able Observer; and it is in this View, that he has prevailed with himself to publish his
own

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own Remarks, rude as they are and unfashioned, that Persons of more Experience may correct, and finish what he has only begun, by pointing out to them Subjects worthy of Examination.

Their Novelty and Singularity is so unquestionable, that if he thought he stood in need of any other Apology, he would have suppressed his Essay, tho' encouraged to the Publication of it by Persons much superior to himself, to whom he had the Honour of shewing some of the most curious of those Objects he describes. He can assure the Learned, that he has wrote nothing but plain Matters of Fact, as he has nothing more in View than a simple Narrative; whatever goes beyond this, and savours of an Hypothesis, he has, as may be expected from a timorous Author, advanced with as much Caution, as he thought necessary

necessary to convince the World, that he endeavours not to derogate from the Respect which may be due to the Sentiments of those who are gone before him, but modestly expresses his own Surmises. If he has been mistaken, he is sensible, that it is a Misfortune, from which Men of superior Talents, and much more Experience than himself, cannot promise themselves to be exempt, especially in Subjects of this Nature, and consequently is disposed to stand corrected, whenever his Mistakes are pointed out to him, with all due Acknowledgement to Friends, if this little Performance attains to a Second Edition. He hopes therefore as an Author, that he may meet with some Encouragement from the Learned to pursue his Researches, and promises, if his Essay meets with Approbation, to do all that lies in his Power to oblige the Publick hereafter with something,

something, if possible, in the same Way, that may claim their Attention with a better Grace, than this does, if it be owing only to a more decent Dress, than he apprehends his present Thoughts appear in, for want of a sufficient Acquaintance with Men of Learning, which he has but just had the Happiness of beginning.





T H E

INTRODUCTION.

NATURE under the Direction of its Creator, tho' prolifick beyond the reach of Imagination, and ever exerting its Fecundity in a successive Evolution of organised Bodies, boundless in Variety, as well as Number, has yet so much of Uniformity in all its Productions, that not only the specifick Ascent, or Descent throughout the whole Scale of visible Beings is easy, and gentle by almost imperceptible Gradations; but also the Subordination of Worlds, if I may so term the several inhabited Portions of Matter, is concerted into a Harmony of Individuals as surprizing, as

B that

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that of the several Species, under which they are ranged.

In this Theory, which is more than a specious System, or a mere agreeable Sally of Imagination, since many Traces of it appear in Nature, a Drop of Water, the Diameter of which exceeds not a Line, may be a Sea, not only as daily Experience shews, in the Capacity which it has of containing, and affording Sustainance to Millions of Animals, but also in the Similitude which these very Animals may bear to several known Species in that part of the Creation, which is the Object of our naked Eyes.

If our Acquaintance with the Microscopical World could be extended beyond the Bounds which Nature has prescribed to it, or even was already carried as far as Observation may in process of Time advance it, the Truth of this Theory would, I believe, appear in a much stronger Light, than our present confined Experience can afford, tho' abundantly sufficient to clear it from the Imputation

putation of a groundless Supposition : And yet imperfect as it is, it wants not Instances to prove, that the peculiar Inhabitants of several Portions of Matter often bear a near Resemblance to each other, tho' they differ extreemly in Magnitude.

The Extreems of Great and Little, as far as our Conception aided by Experience can trace them, are immensely distant from each other ; 'tis nevertheless not unreasonable to suppose, that the whole Sphere of our Knowledge from known Objects of the greatest Dimensions to the minutest microscopical Animalcule, a Million of which are less than a Grain of Sand, would appear but a Point, if it could be compared with the real Bounds of Nature, as much as a little Ant-hill in the Supposition of reasonable Emmets would appear to its Inhabitants upon Comparison, an Infinitesimal of the terraqueous Globe.

A microscopical Animal may therefore in Shape and relative Magnitude be to numberless Inferiors, what

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an Elephant, Ostrich, or Whale is in the several Kingdoms of Beasts, Birds, and Fish; and this in so extensive a Gradation, that the Descent in the Scale of Beings is as boundless to our Imagination, as its Ascent, on the one hand extending towards Immensity, on the other decreasing towards Nothing, ever approaching, for ever distant.

Some general Reflections of this nature succeeding to those late wonderful Discoveries of the Properties of the Fresh-water *Polype*, for which the World is obliged to the ingenious Mr. *Trembley*, induced me to examine, if no Species of Fish could be found in the Sea, which bearing a near Resemblance to it, might be almost in Large, what this is in Miniature, and serve by Induction to clear up those Phænomena at least which escape our Apprehension upon account of the Minuteness of the Object.

The surprising Property it is endued with of reproducing the Parts it has lost, must depend, without Dispute,

pute, even in Objects of a much larger Size, upon a Mechanism of Vessels so minute, that we may securely reckon it among the Inexplicables, tho' justly surmised by Mr. *Reaumur* not to be a Faculty peculiar to this Animal, and since exemplified in some Sea-productions, the *Urticæ* and *Star-fish*, by Mess. *Gerrard de Villars*, *Jussieu*, and others. As an additional Proof I have now by me the Arm of a *Star-fish* repairing its Loss, preserv'd in Spirits, where the protruded Extremity is distinctly visible, as not having arrived to the Diameter of the rest of the Arm, which with some other Objects (whereof mention will be made in the Body of this Essay) I lately sent over to *England* for the Satisfaction of the Curious, and since that have had the Honour of presenting them to the present Worthy President of the Royal Society, as well as several other eminent Members, who upon Examination of them, particularly the Milt-vessels of the *Calamary*, were pleased to encourage me to the Publication of this Essay.

Its extraordinary method of Propagation, which appears to be a true Vegetation, (in which particular I am satisfied that it differs from the *Starfish* by the Discovery, upon Dissection, of Milt and Roe in the Male and Female of this Species) is a Property of the same Nature, equally amazing, and not to be explained, tho' in process of Time it should, as in the amount of our present Discoveries it cannot be instanced in any other Animal, unless the *Barnacle* may be excepted, a small tubiform Animal, which is found adhering in Clusters to Rocks, and the Bottoms of Ships, where they multiply incredibly.

Plate VI.
Fig. 1.

This Sea-production, by what I thought I might infer from an accidental sight of a Few, which I found dead upon the Sea-coast, seemed to bear some Analogy in its Propagation to the Fresh-water *Polype*. The whole Cluster, which consisted of six or seven in Number, adhered together, and were intimately conjoined by their Extremities, as if springing, not like Branches from the Parent's

rent's Body, but like Saplings from the same Root. I can however determine nothing with any Certainty upon this Head, tho' I have since had frequent Opportunities of examining them alive, having often found them at their full Growth single, in the Heat of Summer, at the Distance of two or three Inches one from another.

Their Body, or rather the Case, in which the Fish is inclosed, is a hollow Cylinder, not exceeding, when dried by the Heat of the Sun, as I found them, two Inches in Length, extreamly compact, rough, and black like Shagreen, tipped with a Shell to Appearance bivalve, yet really compounded of five different Parts, and seems capable, while the Animal is alive, of a considerable Extension, or Contraction.

The Head of the Animal is invested with many little Horns, or Arms, gradually lessening in their Length, which appear in the Microscope to be curiously fringed, not circularly disposed round the Mouth,

but taking their Rise nearly from the same Point ; when contracted they form irregular Curves, inclosing one another. The Head and its whole Apparatus may be exerted or retracted at Pleasure within the Cavity of the Shell, each Side of which consists of two Parts, adhering together by a thin Skin, which goes between each Division, and turning upon one common Hinge.

Plate VI.
Fig. 2.

Plate VI.
Fig. 3.

When I had this Sea-production first under Consideration, I had but an imperfect Idea of Mr. *Trembley's* plumed *Polypes*, or *Polypes à panache*, and consequently imagined, that it might be in Large, what they are in Miniature ; but since I have had the Happiness of conversing with that Gentleman, and seeing his curious Discoveries in this Particular, at the same time that I had the Honour of shewing him the Milt-vessels of the *Calamary*, I am satisfied, there is at most but a distant Analogy. They are described by that Gentleman to have about their Head fifty or threescore little Horns, or Arms, which when the Animal is undis-

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turbed, they exert out of a Sheath, or Case, and in Appearance make a circular Motion in the Water, forming a Current, that brings with it the Prey they feed on.

An ingenious Gentleman, * whom I shall have Occasion to cite more at Large hereafter, “ surmises, that “ these plumed *Polypes* are the very “ same Animals Mr. *Lewenhoeck* “ took Notice of, as living in a “ Sheath or Case, (which they fasten “ to the Roots of Duck-weed) and “ having two seeming Wheels with “ a great many Teeth or Notch- “ es, coming from their Heads, and “ turning round as it were upon “ an Axis, which Wheel-work at the “ least Touch is drawn into the Bo- “ dy, and the Body into the Sheath.” In Effect, tho’ they are much less than those discovered by Mr. *Trembley*, they scarce seem to differ in any thing but Size, as one kind of *Polype* does from another ; the little Variety that may arise from the Number, and Disposition of their Arms, which
varies

* Mr. Baker’s *Natural History of the Polype*,
Page 23.

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varies the apparent Wheel-work, not constituting an essential Difference.

Thus this seeming Wheel-work may in Effect be nothing more, than an Apparatus of Horns or Arms similar to that of the plumed *Polypes*, and analogous to the Horns investing the Head of the *Barnacle*, which it exerts for the same Purpose, forming a Current as they do: Which Circumstance, if it appears as probable to others as it does to me, will serve to clear up many Difficulties, that seem to be the Consequence of these microscopical Phænomena, if we suppose, with some Authors, the Wheel-work to be real, by the Rotation of a detached Piece of Mechanism revolving upon its Axis, and not apparent only by the Play and Action of a Groupe of Arms.

Another Instance of an Animal, which is in Large, what some microscopical Animals are in Miniature, is a Species of small Shell-fish, each of them something exceeding in Size a Grain of ordinary coarse Sand, which

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II

which I observed in Rain-water, that had settled upon the Sands in the Cavities of a low Shore near *Lisbon*. I have also found them in Fountain-water, at a great Distance from the Sea.

The Fish appeared in the Microscope to be inclosed in a Bivalve transparent Shell, resembling in Shape that of a Muscle: Its apparatus of Horns or Arms it exerted, or retracted at Pleasure, opening its Shell to an Angle of about thirty Degrees, whenever it exerted them either for the Formation of a Current attractive of its Prey, or for local Motion, which was either Progressive or Circular.

These Phænomena, with some others in which they perfectly agree, I have frequently observed in those minute oval *Animalcules* common in corrupted Water, and have great Reason to think, that they differ in nothing but Size. For altho' I cannot be positive, that I have certainly seen the bivalve Shell, in which I suppose these *Animalcules* to be inclosed, and
which

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which is too minute and transparent to be distinctly visible, yet the Exertion and Retraction of their little Apparatus of Horns or Arms, which I have often observed, as well as their Shape, will appear, I believe, to imply as much to any Person, who will be pleased to observe them with Attention.

This Digression, I hope, wants no other Apology, than that it was intended as a Hint to the Curious, if they should think it worth Notice, to examine the Objects I have mentioned, with more Precision and Accuracy than I can pretend to, for want of equal Experience in Matters of this Nature. To proceed therefore.

The ingenious Mr. *Baker*, *F.R.S.* in his Natural History of the *Polype*, wherein he has most agreeably entertained us with a Variety of Experiments, performed in all imaginable Ways, that could be contrived for the Satisfaction of the Curious, takes Notice, “ that the general
 “ Form of a *Polype*’s Arm, when the
 “ Creature

“ Creature seems Quiet and most
“ at Ease, bears so near a Resem-
“ blance to the Arm of a *Star-fish*,
“ that by examining the Latter, we
“ may form a reasonable Conjecture
“ of many Particulars in the Form-
“ er, which by reason of its Small-
“ ness we are incapable of discern-
“ ing perfectly.” He accordingly
proceeds to an Illustration of Par-
ticulars, and from its Appearance in
the Microscope, as well as the in-
stant Adhesion of Worms, when
they touch but the Extremity of
an Arm, makes it highly probable
that the Arms of the *Polype* are
furnished from End to End with
Rows of little moveable Pipes, or
Suckers, as the Arms of *Star-fish*
are, which serve to catch, and hold
its Prey, even before the Arm can
bend itself to encircle and secure it
perfectly.

This Conformation is so exact,
and the Comparifon fo juft, that
nothing can be added to illuftrate
it, farther than an Inftance of the
fame Nature in the *Calamary*, *Cuttle-
fish*, and *Pourcontrel*, three Species
of

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of *Ink-fish*, which resemble the Fresh-water *Polype* even more than the *Star-fish* do, as will easily appear to every attentive Observer.

An Enquiry into the particular Structure and Mechanism of their Suckers, which is very remarkable, and observed in something of the same View as the *Star-fish* had been taken Notice of by Mr. *Baker*, with all the Exactitude I was capable of, insensibly led me on to the Discovery of other Particulars in the *Calumary* much more engaging, and at last to the Publication of them, with Drawings, as exact as my own unexperienced Direction could procure, which my Readers may apply, whenever they find a Conformity to the Fresh-water *Polype*, as they shall deem reasonable; for in this, I will not anticipate their Deductions by any thing else than a simple Description of this Sea-production; in the Observation of which, tho' extremely common, all Authors, who have hitherto come to my Knowledge, are something defective.

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To these Observations I have added some other microscopical Discoveries, I had formerly made, which I believe are entirely New, and may, I hope, upon that Account prove agreeable to the Publick. Their Novelty and Singularity will perhaps make some amends for my inaccurate and unexpressive Style, which I am so sensible of, that I dare make no other Apology for my Appearance in Print, than that this being the first Essay of a young Author, he hopes in Consideration of that to meet with some Allowances from his learned Readers, in the Perusal of this Performance.

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A N

ACCOUNT

Of SOME

New Microscopical Discoveries.

CHAP. I.

Of the Calamary, and its natural Dimensions.

THE Calamary differs but in few, Particulars from the Cuttle-fish and Pourcontrel, or Sea-Polype, and is, as they are, a Species of Ink-fish. That white friable opake Part, commonly known and called the Bone of the Cuttle-fish, is supplied in the Calamary by a thin transparent elastic Substance like Isinglass. Its Surface, if expanded, is a long Oval, but bent, as it is, the whole Length of its longer Axis, and lodged immediately

Plate I.
Fig. 1.

mediately next the Intestines between them, and the Inside of the Back or Case of the Fish, it incloses and secures them within the Cavity which it forms. The *Calamary* is also more oblong in its Shape ; and the Structure of that curious Part, which forms the Tongue and Throat, appears to be very different from that of the *Cuttle-fish*, when they are both viewed in the Microscope.

The *Pourcontrel*, or *Sea-Polype*, I have never seen ; but from the best Accounts, the principal Difference betwixt it and the *Calamary*, as well as the *Cuttle-fish*, consists in a tubiform Excrecence rising up on its Back, which, as Naturalists have observed, is flexible to either Side, and serves to steer him as he swims along. In other Particulars they so nearly resemble each other, that I thought it sufficient to confine my Observations to the *Calamary*, with a Persuasion, that whatever is curious, and engages our Attention in this, may be found in the other two Species with small Variation.

The

The *Calamary* has ten Horns, or Arms, disposed at equal Distances round a strong circular corrugated Lip, inclosing the Head and its Hawk-bill, like that of a Land-Tortoise, within which he withdraws his Head, when he retires under his Shell. The Bill of this Fish is a horny Substance, both Parts of which are hooked, and clasp one within another : They are secured from Dislocation by the corrugated Lip, which contracts like a Purse round them, and permits only the two Points, or something more to emerge. The Action of the two Parts of this Bill is from Right to Left, and the Opening of it is not, as one would expect, parallel, but perpendicular to the Plane of the two Eyes, which are on each Side of the Head at a small Distance below the Roots of its Arms.

The Arms are not all of equal Length ; eight of them measure something more than one fourth, and the two remaining equal the whole Length of the Fish. The eight short
C 2 Arms,

Of the CALAMARY

Arms, which gradually terminate in a Point, and run tapering from the Root to the Extremity, are somewhat convex on the inner Side, obverted to the Mouth, and furnished with Rows of small moveable Suckers from End to End, but on the outward Side are ridged with two shelving Sides : A transverse Section of these Arms would exhibit a Triangle with a curvilinear Basis. The two long Arms are perfectly round from the Root to five Sixths of their Length, where they assume the Shape of the short Arms, furnished, as they are, with Suckers, but of much larger Dimensions for the most part.

These Arms consist of a Substance somewhat resembling that, which form the Tendons of Land-animals ; and its constituent Parts are so elastic, that whenever it is cut, the Extremities at the Section round themselves instantly, and become convex ; nor does any Ichor flow upon division either out of them, or the cartilaginous Case, which makes up the Body of the Fish, and seems to be

be a Substance of the same Nature, measuring three Fourths of the whole Length of the Fish. But the precedent, as well as subsequent Descriptions will be better understood, if Application be made to the Drawings I have annexed, and to which I refer the Reader throughout the whole Course of this natural History.



CHAP. II.

*The Number, Shape, and Mechanism
of the Suckers.*

Plate I.
Fig. 2.

Plate I.
Fig. 3.

THE Mechanism and Action of the Suckers depends partly upon their Shape, which, when they are extended, resembles nearly that of an Acorn-cup, and partly upon a deep circular cartilaginous Ring, armed with small Hooks, which is secured in a thin Membrane something transparent by the Projection of a Ledge investing its whole Circumference about the Middle of its Depth, and not to be extracted without some Force.

Each Sucker is fastened by a tendinous Stem to the Arm of the Animal; which Stem, together with Part of the Membrane that is below the Circumference of the cartilaginous Ring, rises into and fills its whole Cavity, when the Animal contracts the Sucker for Action: In this State whatever touches it, is first held by the minute Hooks, which insinuate themselves betwixt the
the

the Scales of its Prey, and then is drawn up to a closer Adhesion by the Retraction of the Stem and inferior part of the Membrane, much in the same Manner as a Sucker of wet Leather sustains the Weight of a small Stone.

The Application of more than a thousand Suckers, which the Animal brings to bear at once by clasping (as I have seen it) the short Arms one within another, and thus encircling its Prey, effectually secures it from escaping, and conquers all its Efforts. Upon one of the short Arms I have sometimes counted more than a hundred Suckers, and at the Extremity of the long Arms more than a hundred and twenty. But 'tis impossible to determine their Number exactly, especially in the eight short Arms; for they diminish proportionably in Size from $\frac{1}{20}$ th of an Inch in Diameter to an incredible Minuteness at the tip of the Arm, where they are numerous beyond any certain Estimation.

Of the CALAMARY's Suckers,

The largest Suckers are found upon the long Arms, and measure, in a *Calamary* of sixteen Inches, three Tenths of an Inch in Diameter, and about as much in Depth, when the Cavity is enlarged as far as the investing Membrane will permit.

The Cavity of each Sucker seems to the Eye to open into the tendinous Stem ; which made me at first suspect, it might have a Communication by some sensible Passage into the Body of the Arm, and this Communication occasionally opened or shut by the Action of a Valve ; but I soon undeceived myself, by endeavouring several Times all imaginable Ways to force Air, after I had divided the Stem, thro' the supposed Passage to no Purpose, which effectually excluded all Suspicion of any such sensible Duct.

CHAP.

CHAP. III.

The Tongue and Throat.

INClosed within the Cavity of the horny Bill, which I have described above, is a Membrane furnished with nine Ranges of Teeth for the Commiution of its Food, which forms itself, by the Expansion of the upper and Circumvolution of the lower Part, into a Tongue and Throat. When wholly extended in Breadth and Length, it is nearly a Rectangle; but that Part, where the Membrane is broadest, being bent back, and inclined to about an Angle of 45° , the two Sides at the Bend are gathered, and join by a slender Ligament; below which the inferior Part, by its Circumvolution and the simple Contact of the Sides, forms a Throat, which goes off tapering, while the Expansion of the upper Part performs the Office of a Tongue. When in this Form, 'tis not unlike a Mushroom.

Plate III.
Fig. 1.

Plate III.
Fig. 3.

To

To prepare this Object for the Microscope, it must be expanded upon a concave Object-Glass; which may be most conveniently done, as it is but minute, by insinuating into the Cavity of the Throat-part a fine Needle, by means of which breaking thro' the small Ligament, the two Sides of it are severed without Injury, and laid open to the best Advantage. Then instilling two or three Drops of Water into the concave Object-Glass, wash it successively several Times, using at the the same Time the Point of your Needle, which if gently applied from the Tip of the Tongue downwards in the Direction of the Teeth, will by Degrees separate, and extract out of its Interstices the minute fleshy Parts: Let this be continued, till it appears clear and bright to the naked Eye. The third or even the fifth Magnifier of the double reflecting Microscopes will then suffice to discover the Beauty and Symmetry of its minutest Parts.

I shall give as exact a Description of it as I can express in Words,
from

from whence I refer the Reader to the Drawing both of it, and that of the *Cuttle-fish*, which when viewed in the Microscope will be found to differ from it considerably in the Shape, and Order of its minute Parts.

Plate III.
Fig. 1.
Plate III.
Fig. 2.

A curious Arrangement of nine Rows of Teeth invests in a manner the whole Expansion on one side of a thin transparent Membrane, to which they adhere. The Area of this Membrane, tho' it be so minute in a *Calamary* of the largest Size as not to exceed half an Inch in Length, and one Tenth of an Inch in Breadth, yet affords a sufficient Space to contain without Confusion five hundred and four Teeth of several Shapes, each Row being composed of fifty six.

By Comparison with a small Portion of a human Hair $\frac{1}{10}$ th of an Inch in Length, which I placed upon the Object in the Interstice between two Rows of Teeth, the Length of the longest Tooth appeared in the Microscope not to exceed one Thirtieth

eth of an Inch ; and that of the shortest one Tenth : Their mean Diameter was nearly that of the compared Hair.

They are ranged in exact Correspondence one to the other ; and the Teeth of the corresponding Rows are perfectly similar, that in their Meeting they may coincide together. The two outermost corresponding Rows consist of blunt and pointless Parts, in the Nature of Grinders ; those of the two next in Order are comparatively long, tapering, and finely pointed at the Extremity, in Shape not unlike a Boar's Tusk ; the two succeeding Rows are composed of Fangs, which go off with a Bend, and resemble little Scythes ; the Teeth of the remaining two project three Points, one of which is very short, and the intermediate longest. The middle Range in the Structure of its Parts bears some resemblance to the two Rows immediately adjacent, differing in this only, that the two extream Points of the three, which it protrudes in each Tooth, are of equal Height ;
that

that in the Middle, as in them, emerging considerably above the other two, and causing in some measure the Appearance of a sort of Boats I have seen, beaked at each End, with a short-pointed Mast emerging out of the Middle.

The Teeth, which invest a Membrane of the same Nature forming the Tongue and Throat of the *Cuttle-fish*, differ from those of the *Calamary* in this, that the three middle Rows are composed of Parts resembling hollow Cones, the pointed Extremities of which lie successively each over the Root of that next immediate to it. Every Range, of which there are only seven in this Animal, contain forty four Teeth ; the Amount of the Sum total is consequently Three hundred and eight. They are something more minute than those of the *Calamary*, agreeably to the Expansion of the Membrane whereon they are ranged, the Length of which is three Tenths of an Inch, and the Breadth one Fifth of its Length. The Drawing I have annexed contains but an exceeding small
Portion

Plate III.
Fig. 4.

Portion of the Whole; but as it appeared to me sufficient to shew the Difference betwixt the *Calamary* and *Cuttle-fish* in this Particular, I judged the precedent Description would be well enough explained by it.

It is remarkable that these Rows of Teeth (an Observation which is yet more sensible in the *Calamary*) are so inclined in Proportion to their several Distances from the intermediate Range, that their Points, if the Teeth were carried on each in its Direction, would meet nearly in the Center of the Passage where the Throat opens, and is inserted into a long narrow Gut leading to the Animal's Stomach, so that the Food in its Descent adheres not in the Interstices of the Teeth, but receives during its Comminution a continual Direction, which insensibly disengages and conducts it to the Aperture thro' which it is designed to pass.

Plate III.
Fig. 1.

The Drawing exhibits no more than twenty four Teeth in each Row, whereas

whereas in reality, as I have observed before, there are fifty six in each Range of the Object ; but the Sufficiency of these for the Conveyance of a just Idea, together with the Difficulty of giving the whole Number in their several decreasing Proportions with Exactitude, determined me to confine the Figure to twenty four.

I was assured moreover by an ingenious Person of my Acquaintance, well versed in the Art of Drawing, who took the Object, as it lay, from the Microscope, that it was impossible to draw the whole Number of Teeth in their exact natural Proportions according to their real Decrease, which descends by an almost imperceptible Gradation from each Tooth to the next adjacent, tho' distinctly visible, if distant Teeth be compared together: The Largest are found in the Cavity of the Throat-part.

I observed before, that the Throat is inserted into a long narrow strait Gut, which opens into the Stomach
of

of the Animal : In the Aperture of the Throat, near this Insertion, I once found a small Quantity of comminuted Food, at the same Time that the Contents of the Stomach seemed half digested.

This Circumstance, together with the Apparatus of the Tongue and Throat, inclines me to think, that this Animal may for the better Comminution of its Food, have an Action something analogous to the Chewing of the Cud in some Land-animals. But this is a Surmise, which cannot be depended upon, till more Observations concur to confirm it.



CHAP. IV.

The Body and Intestines.

THE Body of this Fish is a cartilaginous Case, furnished with two Fins, within which the Intestines are inclosed, adhering to the upper Part of it, between a fine transparent Membrane in the Nature of a Mesentery, and that rigid, thin, transparent Cartilage resembling Isinglass, described in the first Chapter. The Representation of the Reverse of the Animal, with its Case ripped open and expanded, will convey a better Idea of what I would express, than I can possibly do in Words.

Plate II.
K. K.

Plate II.
L. L.

Plate II.

Immediately below the Head, (which appears of an oval Shape, when extracted out of the corrugated Lip, that incloses it and its whole Apparatus) is a Duct or Channel, open like a Tunnel at both Extremities for the Conveyance of the black Liquor, with which the *Calamary* discolours the Water, in a View I believe of preventing its Prey from
D escaping,

Plate III.
Fig. 5.

Plate II. C.

escaping, and not of avoiding any Enemies it may have of its own, as has been generally supposed : For by the Remainder of the Food found in its Stomach, it is very clear, that this Fish preys among other Animals upon *Pilchards* and *Sprats*, incredible Quantities of which are taken in the same Nets, with *Calamaries* and *Cuttle-fish* in great Abundance, upon the shallow Shoars near the Mouth of the *Tagus*, whither it is probable they fly for Refuge from their Pursuit.

Plate II.
B. B.

Plate II. A.

This Duct is supported, and the Sides of it kept asunder by two parallel cylindrical Cartilages extending considerably below it, between which is lodged the Vesicle containing the black Liquor, so that its Aperture protrudes itself into that of the open Duct, which I have just described. As to what relates to its Contents, I could observe no more, than that when it is exposed to the open Air, either by forcing it out of the containing Vessel, or even extracting the Vessel itself out of the Body of the Fish, it soon
condenses

condenses into a hard brittle Substance resembling Charcoal, and to be dissolved at Pleasure by Water.

At the Root of this Vessel, examining some *Calamaries* about the middle of *December*, I observed for the first Time two oval Spots about one fourth of an Inch in Diameter, which seemed to be Membranes replete with a glutinous Substance containing the Animal's Spawn : This Spawn appeared to the naked Eye to be small round Specks of a fine crimson Colour, but, when viewed in the Microscope, differed very much from each other both in Size and Shape, a Particular not as yet observed, I believe, in the Spawn of other Fish, the Ova of which are perfectly similar. They were all Oblong, but some of them were more than three Times the Length of others, and seemed to project at one of their Extremities a Confusion of Radii, or the first Lineaments of Arms, as if they tended to assume the Shape of the Parent *Calamary* : The Appearance however was so indistinct, that

Plate II.
E. E.

it afforded no manner of Assurance in that Particular.

In a Female *Calamary*, which I have since observed, the two oval Membranes were much increased in Diameter, and so much extended upwards towards the opening of the Duct, which carries off the black Liquor, that more than two thirds of their Length adhered to the Ink-Bag : Possibly they may in process of Time advance yet much higher, before the Spawn is fit to be deposited. But Time and more Experience must determine this Particular.

Plate II.
F. F.

To return to the Object which I have now before me, and from whence the Drawing was taken : Over the left Cartilage, which serves to support and distend the Duct designed for the Conveyance of its black Liquor, appeared two hollow tubular Vessels, which were intimately united, and cohered together, tho' their Cavities were distinctly separate : Of what Use they may be, unless they serve for ejecting the Spawn, when
it

it becomes fit for Deposition, I cannot well tell : All that I know for certain, is, that two Vessels of the same Nature and Situation in the Male, serve for the Conveyance of the Milt-Vessels out of the Milt-Bag.

On each Side, mostly below the two Cartilages, was an Expansion of Vessels intermixed and disseminated throughout a fat oily Substance, which appearing Black, and replete with a dark opake Matter, made me suspect they were the Vessels in which the Ink of the Animal was formed. But this is only Conjecture.

Plate II.
G. G.

Between these two Expansions is a Layer of whitish Fat covering the Animal's Stomach, which is an oval Sacculus, consisting of a transparent Membrane like a Bladder, two Inches in Length, and one in Breadth, and forms itself at the upper Extremity into a long narrow Gut, one Tenth of an Inch Broad, running up to the Head of the Animal, where the Throat is inserted into it. Within it is included an-

Plate II. H.

other Gut, which in the Microscope appears to be composed of longitudinal Fibres, capable of so considerable a Dilatation, as well as Extension, that after having drawn it out to more than double its natural Length, its Diameter then not exceeding that of a Hair, I have cut off a small Portion, and placing it in a Drop of Water, have with two pointed Instruments dilated it to ten times the Diameter of a Hair : It opens not into the Stomach, but is inserted into the Side of the outward inclosing Gut, about four Sixths of its Depth, runs upward to the Animal's Throat, doubles and adheres to the Root of its Beak, fastens itself by almost imperceptible Ligaments to that Part, which forms the Tongue and Throat, about the Middle of it, and goes off into the Body.

Plate II. 9. Lastly, a thin transparent Membrane covers the lower Part, and joins the Extremity of the Case, under which is contained a Bladder of clear limpid Water, but of what use it may be I cannot tell.

CHAP.

CHAP. V.

*The Milt-Vessels in the Male, with
their Apparatus, as they appear
in the Microscope.*

THE first Appearance I had of the Milt, or any Tendency towards the Formation of the Milt-Vessels, was about the Middle of *December*; before that Time I had examined and dissected several *Calamaries*, without the least Indication of Milt or Roe in either Male or Female, tho' I had discovered the two Channels, thro' which the Milt-Vessels are ejected, some time before: But as they had no other Appearance at that Time, than that of two collateral Tubes open at one Extremity, much resembling the Female Parts of Generation in a Snail, and did not terminate in a long oval Bag extending in a Parallel with the Stomach more than half the Length of the Fish, as I found them afterwards, when the Milt-Vessels, that filled the whole Cavity, were ripe for Ejection; I could then form

no Opinion concerning their Use, more particularly so, since the same Ducts without the Oval-Bag are found in the Female, perhaps for the Deposition of the Spawn.

It is remarkable, that the Bag and Milt-Vessels form themselves gradually; that unfolding, as these frame and range themselves in Bundles so artificially disposed, tho' in different Directions, for their successive Ejection, as they lie nearest the Channels, that an ordinary Pressure will not derange and blend them together.

As the Subject which I have before me had been a Matter of Examination to me some Months before any Signs of Milt appeared, I was much surpris'd to find a new Vessel forming itself in an obvious Part, and replete with a Milky Juice: I thought it strange, that in such a Number of *Calamaries*, I had dissected, in case their Manner of Propagation resembled that of other Fish, not one Male should be found; yet this had been my Conclusion,
if

if in the Course of my Observation a regular Progress in the Expansion of the Milt-Bag, and Formation of the Milt-Vessels, had not presented itself.

Before the Milt-Vessels are perfectly formed, the Semen is diffused at large in that Part of the Bag which has already expanded itself, and nothing is to be distinguished in it even with the greatest Magnifier, but small opaque Globules swimming in a sort of serous Matter without any Signs of Life. When I first made this Discovery, I little surmised, that a new Apparatus was forming itself for the Reception of the Semen, and therefore was much surpris'd to find scattered up and down in several Parts of it spiral, elastick Springs inclosed in a transparent cartilaginous Tube, nor could I then imagine their Use.

The spiral Springs, with their inclosing Case, seem'd then as compleat as they ever appeared to me afterwards, with this Difference only, that as in process of Time, when
the

the Milt-Vessels are perfectly formed, the Spires by their near Approach to each other cause the Resemblance of a Screw, they were now much more loose, and appeared like a Wire spirally twisted : This therefore is the first Part of the Milt-Vessel, that forms itself; for as yet, even the first Lineaments of the other Parts were not discoverable.

In a *Male-Calamary*, which I examined some time afterwards, the Milt-Vessels were almost Compleat; the spiral Spring was Perfect, and acted, as a Counter to the inferior Part in its full Force; but upon account of some other Deficiencies, the Milt-Vessels being unripe for Action, did not operate in the Manner they are designed to do, when the whole Apparatus is Compleat; for their whole Action terminated constantly in breaking their Screw at that Extremity, where it joins the Sucker, which yet by accident they sometimes do, when they appear in all other Respects to be as entirely finished, as those are, in which the Sucker is extracted out of the
Cup

Milt-Vessels, their Apparatus, &c.
Cup or Barrel at the Close of their
Operation.

In the Milt-Vessels of this *Calamary*, at the Bottom of the exterior inclosing Case, I plainly discovered a Valve, which opening Outwards, and thro' which I several Times forced with an easy Pressure one Moiety of the Apparatus, as far as the Cup or Barrel, the inferior Part of it at the same Time emitting the Semen thro' another Valve: 'Tis thro' these Valves, that I imagine the Semen is drawn into, and imbibed by the interior spongy Substance, from whence it is afterwards expressed by the Action of this little microscopical Machine: For in this *Calamary* the Semen was not diffused at Large, as in the First, but had been all absorbed by the Multitude of Milt-Vessels which were already formed, and might amount in Number to several Hundreds.

In a third *Calamary*, which was the Largest I had ever seen in the Course of this Enquiry, upon Dissection the Milt-Vessels appeared in the
Microscope

Microscope to be compleatly formed, and were so ripe for Action, that several exerted themselves, before I could place them upon my Object-Plate: The Drawings of Plate III.

Plate III.

Fig. A. 6.

7. 8. 9.

Fig. A. 6. 7. 8. 9. were taken from these, to which I refer the Reader in the Perusal of the subsequent Description.

The outward transparent Case is Cartilaginous and Elastick: Its upper Extremity is gathered into a round Head, which is in Reality nothing more than the Top of the Case involuted into itself, and by that Means closing the Orifice, thro' which the interior Apparatus springs in the Time of Action.

Within this is contained a transparent Tube, elastick, as it appears from the Phænomena, in all Directions, and forcing its Way wherever it finds a Passage, which tho' the Continuation of it is not equally sensible in all Parts, may be easily discovered in a Course of Experiments to invest the Screw, Sucker, Barrel, and that spongy Substance, which

which imbibes the Semen. The Screw is inserted in the upper Part of it, and throws out of the Head of it two slender Ligaments, which fasten it with the whole annexed Apparatus to the Top of the outward Case ; the Sucker, and Barrel or Cup, are lodged in the Middle of the Tube, and the spongy Substance containing the Semen distends the lower Part, all which will be better understood by a simple View of the Drawings.

Plate III.
Fig. A. 6.
&c.

I shall now proceed to the several Phænomena's, that appear'd in the Action of this minute Machine, which to me at least seem'd so surprizing and inexplicable, that I think myself oblig'd to premise, that I am in no wise answerable for any seeming contradictory Consequences, which may possibly be drawn from Matters of Fact I don't pretend to account for : All I can assure the Publick of, is, that they are literally true just as they are related, and were seen by several Persons, as well as myself. The Objects I have now by me preserved in Spirits of Wine, which
tho'

tho' they retain'd their Activity for more than twenty Days after they were taken out of the Body of the Fish, and immerf'd in Spirits, without any fenfible Diminution, yet now have in a Manner totally loft it, tho' they remain to all Appearance in the Microscope perfectly the fame. If therefore any of my Readers defire to verifie the Facts I have mentioned, they muft apply in the Seafon for fresh Objects, and do their utmoft to procure the Milt-Veffels when perfectly ripe for Action; for thefe only will answer to all the Phænomena I have taken Notice of, tho' the lefs Mature will fuffice for moft of them.

CHAP. VI.

The Phænomena that appeared in the Action of the Milt-Vessels upon several repeated Experiments.

THO' many of the Milt-Vessels, when they are ripe for Action, and disengaged from that glutinous Matter which surrounds them while they are in the Milt-Bag, will act immediately in the open Air, for which perhaps the slightest Pressure during Extraction may be sufficient, yet the Generality of them will not only bear a Translation to the Object-Plate, and lie quiet for Observation, but also require a Drop of Water to moisten the upper Extremity of the inclosing Case, before they begin to Operate.

Upon Application of this, the Extremity begins to evolute, and unfold itself, and the two slender Ligaments, which emerge out of the Case, turn and twist themselves in various Directions: At the same Time the Screw moves upwards with a slow Motion,

Plate III.
Fig. A. 8.

Motion, the Spires at the Top gathering close together, and acting against the Head of the Case, while those at the Bottom advance proportionably, and seem to be continually succeeded by others out of the Head of the Piston; which Succession I believe to be apparent only, and not real, the Appearance being owing to the Nature of the Motion in the Screw: In the Interim the Sucker, and Cup or Barrel, move gently on in the same Direction; and the inferior Part of the Apparatus, which contains the Semen, extends itself in Length proportionably, with a Motion at the same Time upwards, which may be perceived by an increase of the Vacuity at the Bottom of the Case. Soon after this the Top of the Screw, with its inclosing Tube, appears out of the Head of the Case, and as it is there fastened by its Ligaments begins to bend: The Motion of the whole continues thus slow and gradual, till the Screw, Sucker, and Cup have forced their Way, and emerged totally, when at that Instant the Remainder of the Apparatus

Apparatus springs out at once, the Sucker separates from the Cup, the seeming Ligament below the Cup swells out to the Diameter of the inferior Part; the inferior Part, tho' distended considerably in Breadth more than it had been in the Case, extends itself to five times its original Length; two Knots, between which the Tube contracts itself in Diameter, form themselves, each at about the Distance of one Third of the Whole from both Extremities, and the Semen flows out of the Cup, consisting of small opake Globules swimming in a sort of serous Matter, just in the same Form, and without any Appearance of Life, as I had seen it before, when diffused at large in the Milt-Bag. Its Appearance after the Operation you have in Plate III. *Fig. A. 8.* in which it is to be observed, that the fringed Edges between the two Knots appear upon Examination to be nothing more than the interior spongy Substance broke and disjoined at almost equal Distances, as will be clear from the subsequent Phænomena.

Plate III.
Fig. A. 8.

E

Some-

Plate III.

Fig. A. 9.

Sometimes the Screw together with the Tube breaks just above the Sucker, and the Sucker remains in the Cup, of which I have also given a Drawing: In that Case the investing Tube closes instantly at the Extremity of the Screw, as far as it will permit, and contracts itself nearly in a Cone, which plainly indicates its great Elasticity in this, as its Conformation to the Shape of the inclosed Substance upon the least Change does in every other Part.

At first View an Observer would be inclined to think, that the Action of the whole Machine is to be derived from the Spring of the spiral Screw; but the following Experiments, which I tried with a View of satisfying myself in that Particular, not only evince the Falseness of that Supposition, by demonstrating that the Screw can at most act but as a Counter to a Force entirely latent, but afford a Train of Phænomena so surprising, that they totally silenced all the Hypotheses I was capable of forming. The
Experi-

Experiments were tried upon Milt-Vessels, which tho' not sufficiently mature for the Ejection of the Sucker, Dilatation of the seeming Ligament below the Cup, and the Expression of the Semen, had already attained the full Force requisite for the Exertion of the interior Apparatus out of the inclosing Case; thus they compleatly answered my present Purpose, as well as the most mature could, and remedied the Misfortune I had of losing the only Parcel of mature Milt-Vessels I have found in the Course of my Enquiry, which I had laid by for farther Observation. These I distinguish from the mature Milt-Vessels by annexing to each of them in the Drawing the Letter *B*, the first Figure of which represents the ultimate Termination of the whole Action upon the simple Application of Water to the Head of the inclosing Case.

Plate III.
Fig. B. 10.
Plate IV.
Fig. B. 1,
2, 3, &c.

Plate III.
Fig. B. 10.

If the Milt-Vessel be divided just below the Cup, that Part which contains the Semen extends itself instantly; and tho' a Part only, and not the Whole of it springs out at

Plate IV.
Fig. 4. B.

the Opening, as it does when not severed from the rest of the Apparatus, yet upon Application of Water it works itself out by Degrees with a slow Motion, and emerges almost entirely out of its Case.

Plate IV.
Fig. 1. B. If the lower Extremity of the outward Case be cut off, it distends the seeming Ligament below the Cup to an inconceivable Tenuity, breaks it without deranging the Screw, or causing any Alteration in the superior Part of the Apparatus, and goes out at the Opening.

Plate IV.
Fig. 6. B. In one of these Experiments, the seeming Ligament breaking after Distension, struck with such Smartness the Side of the inclosing Case, that, tho' cartilaginous, its Extremity forced its Way thro' by its Elasticity, and retired twisting itself again into the Case; which can be accounted for no other Way, than by supposing it extreamly elastick, and its Force upon this Occasion something analogous to that of a Silken Thread, which if suddenly emitted after Distension with a certain Direction that
it

it receives from a peculiar Slight of Hand, will open itself a Passage thro' a Sheet of strong Paper.

If the Milt-Vessel be divided both above and below the Semen, it emerges at the two Extremities, by extending itself in both Directions, which being contrary to each other, detain it in the Case with this additional Effect, that it renders the inclosing Tube conspicuous, by severing asunder at some of its Divisions the spongy Substance which contains the Semen. I mean by Divisions the Rings throughout its whole Length, resembling those of a Worm, tho' not so regular, as they appear thro' the greatest Magnifier of the common double reflecting Microscopes ; yet with the third Magnifier, from which these Drawings were taken, they are seen as exhibited in the Figures, like a Fringe investing the Edges. I have sometimes upon this Occasion counted no less than nine Separations, tho' no more than four appear in the Drawing, for in this Particular there is no determinate Regularity.

Plate IV.
Fig. 8. B.

If the least Orifice be opened with a Lancet in the Side of the outward Case, it instantly conforms itself to it, and comes out double.

'Tis observable also, that the Screw upon Separation ceases in every respect to operate, and loses irrecoverably its Activity; which is an evident Proof, that the whole Force of the Milt-Vessel is to be derived from the Action of the inferior Part.

The Application of Water is for the most part necessary, and yet the Milt-Vessels will often act without it: Spirits of Wine will also suffice, tho' the Effect is considerably flower, and the Spring, with which the inferior Part at the close of the Operation, when regular, suddenly starts out, is totally impeded; but this is to be understood of a single Milt-Vessel placed upon the Object-Plate; for when the whole Bag is immersed in Spirits, even so that the Liquid has free access to the whole Collection, it causes no other Alteration, than

than that the inferior Part is somewhat extended in Length, and recedes some little from the Bottom of the outward Case. Oil has no manner of Effect in any respect whatsoever, tho' more lubricating than any other Liquid.

Upon summing up these several Phænomena, and comparing them together, it occurred to me to examine, what could be the Reason why the inferior Part acted upon the Cup, Sucker, and Screw in its regular Operation, without bending the seeming Ligament between it and the Cup, and filling up the intermediate Vacuity ; as also, why the same Part, which upon opening the least Passage forces itself through in any Direction, should leave an empty Space at the Bottom of the outward Case. With this View, I put several Milt-Vessels successively into the smallest Receiver of an Air-Pump, and extracted the Air with the utmost Care ; for I had concluded certainly, that a Body of condensed Air was lodged in each Vacuity, when to

my great Surprize, it had no Manner of Effect upon them ; the Microscope exhibited them, after they were taken out of the Air-Pump, unaltered, and all of them acted upon the Application of Water with the same undiminished Force, as the rest of them had done before.

To conclude, if I had ever seen the supposed Animalcules in the Semen of any living Creature, I could perhaps be able to determine with some Certainty, whether they were really living Creatures, or might possibly be nothing more than immensely less Machines analogous to these Milt-Vessels, which may be only in Large, what those are in Miniature. For by Mr. *Lewenboeck's* Calculation of the Number and Size of the Animalcules in the Semen of a *Cod-fish*, one Million of them would scarce equal one of these Milt-Vessels, consequently where Twenty five of these would appear at one View in the Area of a Microscope, Nineteen Million, Six hundred, and Twenty five thousand would appear
of

of those. Now in the Hypothesis, that what has been hitherto taken for Animalcules are only Machines, exerting themselves, as they do at different Times, in different Circumstances, as the several Obstacles which impede their Action are removed, let us suppose, that Ten thousand of them, which is an Object of sufficient Consideration in so much Confusion to induce us to pronounce the whole Alive, act and exert themselves together, and that the Operation is not finished, as in the Milt-Vessels of the *Calamary*, in less than the Space of thirty Seconds, or thereabouts; I say, if we suppose all this, as there is a continued Succession, the whole Scene of Action will not be finished under sixteen Hours, and the supposed Animalcules will appear to die successively, as they have been observed to do in less Time than the Space assigned, when the same Portion of Semen has been under Inspection for a long Time. If this is not the Case, 'tis hard to say, why living Animalcules should not be found in
the

the Milt of this Fish, as well as the Semen of other Animals, which yet never appeared even upon the immediate Examination of Milt-Vessels, which had been taken out of the Body of the Fish while alive.

If we add to this, that these Milt-Vessels, when left in the Body of the Fish, and not exposed to the Air, will retain their Activity for some Days after it is dead, which they instantly exert upon the Application of Water with the same Force, and that something is requisite in the Nature of a Menstruum, or otherwise for the Removal of Obstacles, which impede their Action at all Times, the Comparison will appear yet more just to those, who may hereafter observe in the Microscope their various Twistings, Turnings, Dilatations, Extensions, Motions, in fine, in every Direction, during the Time of Operation. But, as I have already premised, I own myself no competent Judge in this Particular, and consequently propose it only by way of Question to be resolved

resolved by Numbers of the Curious, who being more familiar with the Microscope than I am, are better able to draw Consequences from Observation with some Degree of Certainty in this Particular.



CHAP.

CHAP. VII.

The Farina Fæcundans of VEGE-
TABLES.

WHAT I have advanced in the precedent Chapter concerning the Analogy between the Milt-Vessels of the *Calamary*, and the supposed Animalcules in *Semine Masculino*, will, I believe, appear to be something more than a mere Surmise, or bare Possibility, if Mr. *Lewenhoeck's* Observations of the (a) Disruption, or Unfolding of

(a) “ Aliis in locis, ubi fatis multa animalcula sibi mutuo adjacebant, multa apparebant animalcula sphæram pellucidam repræsentantia, quorum singula quasi cincta jacebant materiâ quâdam orbiculari, non aliter quam si imaginaremur sphæram illam pellucidam animalculo fuisse inclusam, animalculum vero cinctum fuisse materiâ quadam aqueâ viscosâ, eamque materiam iterum cinctam fuisse membranâ ; & membranâ illâ disruptâ, tum demùm particulam sphæricam, materiamque eam cingentem apparuisse.” *Lewenhoeck*, Ep. 137. datâ ad Reg. Soc. Tom. 3. pag. 309. ed. Lat. Lugd. Batav. de animalculis in semine Aselli majoris.

some,

some, the (b) Change of Shape in others upon their seeming Death, and the utmost Extent of the progressive Motion of each Animalcule, which exceeds not the (c) Diameter of a Hair, be considered attentively, with all the Consequences that may be drawn from them; particularly, if we add that these Alterations must be owing to some interior Change depending upon a hidden Mechanism, and not to their extream Tenderness, as Mr. *Leuwenhoeck* imagines; since

“ Particulas has oviformes existimavi animalcula esse disrupta, quod particulæ hæ disruptæ quadruplò ferè viderentur majores corporibus animalculorum vivorum.” Ibid. idem de iisdem animalculis.

(b) “ Corpus horum ultimorum animalculorum sæpiùs figurâ mutari animadverti, præsertim evaporatâ humidâ materiâ, in quâ eadem animalia vivunt, & natant.” Idem de animalculis in femine Canis. Tom. 3. pag. 160.

“ Ex tot millibus animalculorum, quæ Arietum testiculis exempta, à se invicem separavi, ac quorum pleraque etiamnum apud me sunt, nullum cernere licuit, quod disruptum fuerit; verùm sæpiùs comperi eorum corpora, dum succus exhalaretur, plana reddi.” Idem Tom. 3. pag. 309.

(c) “ Hicce progressus non majus habebat spatium, quam quod capilli diametrum æquaret.” Id. Ib.
“ Non

since the Instance he gives of their (d) subsisting upon his Object-Glass five entire Months, imports the exterior Case at least to be very durable, perhaps cartilaginous like that of the Milt-Vessel of the *Calamary*.

In effect, if my Conjecture prove agreeable to Truth, which in process of Time more exact Observations may determine, the Analogy between the Vegetable and Animal World in this Particular will appear to be still greater than has been hitherto imagined, as the Nature of the *Farina fœcundans*, and its Action upon the Application of Water, not unlike that of the Milt-Vessels mentioned above, imply something of a similar Mechanism within the Globules contrived for the same Purpose.

“ (d) Non rarò accidit, ut animalculorum ex
 “ Arietum semine masculino (quæ per quinque con-
 “ tinuos menses vitro imposita jacuerant, atque
 “ microscopiis opposueram) corpora exiguo peni-
 “ cillo in aquâ pluvîâ madefacto, quam lenissimè
 “ reciproco motu fricarem, &c.” Ep. 137. ad
 Reg. Soc. Tom. 3. pag. 305.

This

This curious Particular of Natural History, which I discovered some time ago, may, I doubt not, be much more illustrated in Time, particularly, if the Farina fœcundans of any one Vegetable should offer itself, which being as large, or near as large in Proportion to that commonly found upon Plants, and hitherto observed, as the Milt-Vessels of the *Calamary* are to the Animalcules in Semine, might afford us Observations much more exact concerning the Nature of it, and let us into Secrets attainable at present by Conjecture only in Bodies so very diminutive, as these Globules usually are.

At first, Naturalists were divided about the Use of this Farina, or Dust found upon the Stamina of Flowers. Mr. *Tournefort* took these Stamina to be no more than a kind of excretory Ducts, and the Farina an Excrement of the Food of the Fruit, or Embryo-Plant, discharged by Filtration. But Mr. *Morland*, Mr. *Geoffroy*, and others found a nobler Use for it, and were of an Opinion, which
appears

appears to be the most agreeable to Truth, that it is this Dust, which falling on the Pistil, impregnates and fecundifies the Grain, or Fruit inclosed therein; and hence it is called the Farina fœcundans.

The Universality of this Farina fœcundans, no Flowers being to be found without it; the Care with which it is lodged in Capsulæ at the Head of the Stamina round the Pistil; the regular Uniformity in the Shape of every Globule of the same Species; the Nicety with which the Apices or Capsulæ are suspended upon the Stamina, so as to be moveable with every Breeze of Wind; the Observations of Country Farmers, who have ever experienced, that nothing is more detrimental to their Crops than Rain, when the Corn and Trees are in Flower; the Result of several Experiments, and Consequence of cutting off the Pistils before the Seed had been impregnated; the Length of this Pistil, which in Plants that bear their Flower erect is shorter than the Stamina, in others longer; its Disposition, insine, Rows of Papillæ,

pillæ at the Head, each with an Aperture proportioned to the Size of the Globules of Farina; its Canals, &c. appropriated in the exactest and nicest Manner for conveying the impregnating Substance of the Farina to the Uterus, or Ovary, together with the microscopical Observations of the Embryo-Seed before and after Impregnation, all concur to place this Sentiment in so strong a Light, and express the strict Analogy, that admirable Uniformity, which Nature seems to affect in the Means it makes use of to attain similar Ends, that few Systems carry with them more seeming Characteristicks of Truth.

To illustrate therefore this whole System, as far as I imagine my present Discoveries have carried it, I have chosen the common Lily, and annexed Drawings first of the whole Apparatus contained in the Calix, whereby the Stamina with their Apices, Uterus, Pistil, &c. are exhibited, just as they were copied from Nature without the Help of the Microscope; next of one of the Papillæ, containing a Globule of Farina as it
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appeared

Plate V.
Fig. 1.

Plate V.
Fig. 2.

Plate V.
Fig. 3.

appeared to me thro' the third Magnifier of the common double reflecting Microscopes; and thirdly, a transverse Section of the Uterus from the same. The Head of this Pistil is composed of three Lobes, each of which being excavated on the Outside to an obtuse Angle, meet with their several Angles in the Center, and thus perfectly close coinciding in every Point. The Labia of these Lobes are invested to some Depth with Papillæ, such as Plate V. *Fig.* 2. exhibits, and this not only on the Outside, but on the Inside also, as appears by the Head of the Pistil, Plate V. *Fig.* 1. where one of the Lobes is thrown open, and separated from the other two, to shew the Disposition of the Papillæ on the Inside.

The Body of the Pistil is also divided into three Parts, united by the exterior Membrane which invests the Whole. This Division is a Continuation of that same Separation, which distinguishes the Head of the Pistil into its three Lobes, with this Difference only, that

that by an insensible Decrease of the Excavations without, and the Angles within, the Pistil becomes gradually round on the outside, and leaves a triangular Void within, some little Way below the Head. Each of these Parts is a Groupe of longitudinal Tubes, of which the Papillæ, as being the Heads of them, are an Expansion, and may be traced throughout the whole Length of the Pistil by means of the Microscope, in which a transverse Section of it in any Part appears as if perforated with innumerable Holes. These longitudinal Tubes are so concentrated in the Medulla of the Uterus (which is a Substance much more dense than the Placenta, and situated in the Middle of it) that each Grain or Seed may be impregnated by means of a small Stem which communicates with it. * Thus the Medulla seems to be an Expansion of

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the

* *In the Flowers of Holyoke, which bear their Stamina upon the Pistil itself, and resemble those of the Mallow in almost every Particular, but that of Size, which they much exceed, the Continuation*

Of the Farina Fœcundans

the Tubes of the Pistil throughout the whole Depth of the Uterus ; as the Placenta, which surrounds the Cells, wherein the Seeds are contained, appears, from a tranverse Section of each viewed and compared in the Microscope, to be an Expansion of the Tubes of the Pedicle.

Now, by the Consequences that may be drawn from these Observations, it appears, that the Farina enters into the Papillæ, where falling as far as the decreasing Diameter of the Cavity will permit, it injects the impregnating Substance with which it is replete, into the Tubes that lead to the Uterus, as will appear hereafter, when we come to describe the Action of the Farina. 'Tis consequently a Mistake to imagine, as some Authors have supposed, that the Cavity, which appears to run thro' the whole Length of the Pistils
of

tion of the longitudinal Tubes, which fill the whole Cavity of the Pistil, separable from one another like the Hairs of a Brush, and equal to them in Diameter, as well as their Concentration in the Medulla of the Uterus, is distinctly visible even to the naked Eye, and consequently a proper Object for Examination in this Case.

of some Flowers, is the Canal designed by Nature to convey the Farina to the Uterus. For to abstract from several Flowers, in the Pistils of which no such Cavity appears, nor any thing more than a small Depression in the midst of the Groupe of Papillæ, 'tis evident in the Subject we have before us, that the three Lobes are so adapted, and the Papillæ on the Inside of their Labia interwoven in such a Manner, that the Farina cannot possibly impregnate the Seeds in the Ovary, any otherwise than as I have described.

The Structure however of the Papillæ is a much stronger Argument for what I advance, than their Disposition on the Head of the Pistil, and may be distinctly seen, just as they are exhibited Plate V. *Fig. 2.* through the third Magnifier of the common double reflecting Microscopes, if after they are cut off with the Edge of a Lancet, they are exposed upon the Object-Plate, separated from each other by means of two or three Drops of Water ; in which Case,

tho' they are exceeding transparent, not only the Aperture and Cavity designed to receive the Farina will be visible in several, according to the Light they happen to be placed in, but also, if the Apices of the Stamina be first so applied to the Head of the Pistil, as to leave a considerable Quantity of Farina adhering to it by means of the Oil it emits, or otherwise, some at least or other of the Papillæ will be found, into which the Farina has insinuated itself, containing a Globule as delineated.

This is the Method I made use of in the Examination of these Vessels, which I frequently practised with the same Success. Possibly, if the Head of the Pistil had been moistened with Water before-hand, this Water had served as a Vehicle, and the Globules insinuated themselves into a much greater Number of the Papillæ than I usually found. * The Reason of my Surmise,

** I am obliged to observe here by way of Note, that the Consequence I have drawn here, is not so*

mise, that something of that Nature may be necessary not only by way of Menstruum, but also as a Vehicle, is, that having applied in great Abundance the Farina of one Species of Flower to the Pistils of another, before the Seed had been impregnated, which I took care to prevent by depriving it of its own Stamina, this with a Design of discovering whether the Farina of one would serve to impregnate the Seeds of another, at least in those Species that differ but little in Size and other Circumstances, the Consequence was, that I found the Heads of the Pistils had extruded in the Night Time so great a Quantity of Juice, that it hung in a large Drop of a yellow Cast, tinctured, as I suppose, by the Abundance of Farina which I had applied; whereas the Heads of those Pistils, tho' of the same Species, to which no Fa-

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rina

so just as I at first imagined; for I have since applied to the Pistil of the Lily its own Farina in great Abundance without any such Effect: The Phenomenon however deserves to be taken Notice of, and arose from the Application of the Farina of a Species of red Flag-flower to it, instead of its own.

rina had been applied, were totally dry, and remained unaltered.

From the precedent Observations 'tis easy to infer, that the Farina falling on the Heads of the Pistils dissolves in the Papillæ, and the subtillest of its Parts only penetrates into the Tubes. Mr. *Geoffroy* had surmised as much long before ; his Sentiment however in this Particular has hitherto had little more to depend upon than mere Conjecture, the Action of the Farina upon infusing it in Water having escaped Observation till this Time, as appears by the express Assertion of several Naturalists, who affirm, that Water causes no Alteration in it. This Mistake is owing to their not being present at the Time of Action ; for this Action in most Species of Farina, especially when fresh gathered and perfectly ripe, begins and ends in four or five Seconds of Time, and requires that the Observer should have adapted his Microscope to the due focal Distance before the Application of Water.

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The Farina fœcundans of the *Lilium flore reflexo* was the first, in which I discovered this Action of the Globules. For upon viewing an Infusion of it in common Water, I thought I perceived some Alteration in these minute Bodies, as if the Shell or Case had emitted through a small Aperture, and shed a long Train of minute Globules, which appeared but as Points in the Microscope, involved in a filmy Substance, as the Eggs of some aquatick Insects are, and in Effect not unlike them. This Particular must have offered itself to me long before upon several Occasions, in which I had observed the Farina of different Flowers infused in Water ; but, it seems, I had overlooked it, till this Time, persuaded as I imagine others may have been before me, that this filmy Substance was some extraneous Matter, which Chance had placed upon my Object-Glass, or conveyed together with the Water. But however that had been, I immediately upon this Occasion applied some fresh Farina ; and having first fitted the Microscope to a due focal Distance, dropped

dropped a small Quantity of Water with the Tip of a Pencil upon the Object, when in the Space of some few Seconds I distinctly perceived a Train of Globules, involved in a filmy Substance, to be ejaculated from within these minute Bodies, and contorting itself from one Side to the other in different Directions during the Time of Action, which does not last above a Second or two of Time, and may be easily understood by a View of Plate V. *Fig.* 4. 5. tho' the Drawings were taken from that of the Mallow, as the several Species of Farina differ but little from each other in this Particular, their Action in general resembling that of an *Æolipyle* violently heated.

I have since repeated this Experiment upon almost every Species of Farina, that has offered itself, with the same Success, particularly upon that of the Pumpion, which afforded me a more than ordinary Satisfaction, not only because the Globules are larger than those of the Farina of most Flowers, and may consequently be

be easily observed with the second Magnifier, where I had the Advantage of a larger Field, but also because I could plainly perceive, by two or three lucid Specks which continually shifted their Places during the Time of Action, an intestine Commotion within the Globules, and a stronger Ejaculation of the emitted Particles.

The Sum of my Observations is, that tho' all Species of Farina have this Action in common, and impregnate their respective Seeds in the same Manner, as the Result of repeated Experiments upon many Sorts inclines me to believe, yet it is particularly remarkable, and better to be observed in those Kinds which are Opake, the emitted Substance of the transparent Species appearing in the Water but as a thin pellucid Vapour, for which Particular I instance that of the Nasturtium; so that I easily imagine, that in some of this Sort, which are extreamly minute, the Effect may not be easily, if at all visible, the emitted Substance being
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proportionably thinner, finer, and more pellucid.

* But however that be, tho' I frequently observed that Water causes no visible Alteration in the Farina fæcundans of the Pomgranate, Asparagus, Hop, and some others of the transparent Species, I am yet inclined (rather than suppose that Nature is not agreeable to itself in the Means it makes use of for attaining similar Ends) to believe, that the Non-appearance of this Action is either owing to the Minuteness of these small Bodies, ten of them scarce equalling one Globule of the Mal-low-Farina, or to their Shape and Structure, each of them being oval, extreamly light, yet heavier at the smaller End, which causes them to
emerge

* It would be no more than a mere conjectural Supposition, to imagine, that possibly the fretting of Wine in the Spring Time, when the Vines are in Flower, may be owing to a Fermentation excited in it by the subtle Matter emitted out of the Globules of Farina, with which the whole Air, no doubt of it, is at that Time impregnated; yet, as it appears by the Microscope, that this Matter is inconceivably fine, subtle, and penetrating, the Supposition carries with it an Air of Probability.

emerge in Water with the large End upwards. Now if the emitted Substance goes out at the smaller End, as it is reasonable to suppose, since the Transparency, as well as relative Levity of the large End, denotes that this Substance is placed at the opposite Extremity, 'tis plain that the Action of the Farina cannot be sensible to the Observer; and this is the Case of all those Species, in which this Effect has not been visible.

Secondly, That few of the Globules will act, unless the Farina be fresh gathered, and even then not all of them, owing, as I suppose, to their not being equally mature, and ripe for Action.

Thirdly, That some Species of Farina act with so much Force, that when two Globules are contiguous, the Action of the ejaculated Substance in one will repell the other to the Distance of six or seven times its Diameter.

Fourthly,

Fourthly, That some Globules of all the Species of Farina which came under Observation were fairly burst and broke open ; but in most, the Aperture through which the interior Substance passed, was imperceptible even through the greatest Magnifier.

Fifthly, That the Seed does not contain the Plant in Miniature, as some other Authors suppose, before Impregnation, but that the Farina of the Flower contains within itself the first Germ, or Bud of the new Plant, which requires nothing more to unfold it, and enable it to grow, but the Juices it finds after Deposition ready prepared for it in the Ova. For if in Consequence of the Observation, which has been already made by many Naturalists, that the best Microscopes discover nothing in the Embryo-Grains, till the Apices have shed their Dust, when first is perceived in the Vesciculæ the true Germ, or a small greenish Speck floating in a limpid Liquor, where before that nothing could be discovered but the mere outward Coat
or

or Skin of the Grain entirely void; I say, if in Consequence of this Observation any Naturalist will duly consider, and compare this greenish Speck or Globule with those involved in the filmy Substance emitted out of the Farina; it will appear to him, I believe, as it does to me, highly probable, that each of those contained in the Farina is a real Germ, and that it is not impossible, that one Globule of Farina may be sufficient to impregnate the whole Uterus.

Sixthly, That the true Reason why Rain is so detrimental to Plants and Trees in Flower, is not because it washes off the Farina, but because it causes the Globules to dissolve on the Stamina, before they can reach the Pistil through which their impregnating Substance is conveyed to the Uterus. Possibly it is upon this Account that the Globules of Farina are never found equally ripe at the same Time, and mature for Action, as I observed before.

Seventhly, That by the Force of this Action the impregnating Substance is injected into the Channels
of

of the Pistil leading to the Uterus, which Channels are discoverable by means of the Microscope in the Pistils of most Plants, but particularly in that of the Lemon, which if cut transversely, and a thin Slice placed upon the Object-Glass, will appear rayed like the Lemon itself, and exhibit the Channels, which lead to every Cell or Apartment, where the Embryo-Seed is lodged. As to the Papillæ, which are the Heads of these Canals or Tubes in many Flowers, it is to be noted, that as Nature is not uniform in this Particular, these Tubes with their Papillæ are not to be found upon several Plants, yet so that their Absence is supplied by some other Means, and the Process of Impregnation in general the same in all. A particular Instance of this may be assigned in *Maiz*, or *Indian-Corn*, where the silken Filaments supply and perform this Office, which Mr. Logan observes (*Phil. Transf.* Numb. 440. Pag. 192.) correspond so exactly to the Number of Grains, that if you take off one Part of the Silk, and leave another, there will be in
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the Head of the Plant, the exact Proportion of full Grains, according to the Quantity or Number of Filaments you leave upon it.

Eighthly, That tho' common Water is sufficient to excite this Action in the Globules, yet the Juice that may be expressed from the Uterus, if applied, has a more immediate Effect, and appears to be more powerful.

Lastly, That as to what relates to the Reason, why Water has this Effect upon the Globules of Farina, the Truth will, I believe, remain a Secret. I had at first conjectured, that this filmy Substance involving the emitted Particles was composed of a kind of Filaments, dry and elastick, which upon the Admission of Water into the Cavity of the outward Shell or Husk, dilated, and caused that sudden Emifion of the interior impregnating Matter : But the accidental Tryal I made of some acid Liquors, as the Juice of Lemon, and Vinegar, instead of Water, which proved in-

G effectual

effectual in the Production of this Action, as I imagine all Acids will, convinced me, that it must depend upon a Mechanism entirely latent, and not attainable even by Conjecture in Bodies so very diminutive.

This is all I have as yet been able to discover concerning this Phænomenon of the Farina fœcundans. To conclude therefore these Observations, which have something of a mutual Relation, before I enter upon others of a different Nature, in such a Manner, that nothing may be omitted which is pertinent to them, it will not be improper to remark, that whoever impugns this seeming Analogy between the Animal and Vegetable World, which I think I can reasonably infer from the precedent Discoveries, by endeavouring to prove, that what has been hitherto taken for Animalcules in the Semen, are really such as they have been supposed to be, and not minute Machines resembling those of the *Calamary*, must among many other Difficulties, which have been started
by

by several other Authors against Mr. *Lewenboeck's* and Mr. *Andry's* System in particular, answer these following Queries: Why if they are really Animalcules of the aquatick Kind, the Element they live in is by its Viscidity so improper for them, that, as Mr. *Lewenboeck* himself observes, unless first diluted by Water, they lie absolutely motionless in the densest Parts of it upon account of its great Consistence? Secondly, What is obtained in point of Knowledge, by maintaining, that as Animals they in any wise concur to Generation, since the Question still recurs, how these Animals are generated, unless they are pleased to make the Process infinite? Thirdly, Why there should not be as much Reason, if we make the Wisdom of the Almighty, as far as we can possibly trace, our Standard in this Particular, in asserting that the Fœtus is generated from a Lifeless Point of Matter, as in affirming that it proceeds from an Animalcule? And Fourthly, Why in young Subjects, the Animalcules, if such, should remain so long imperfect, as to appear for

several Years, according to Mr. *Lewenboeck's* Observation, in no other Shape than that of a lifeless floating Point or Globule, which to me seems to import something analogous to the gradual Formation of the Milt-Vessel in the *Calamary* already described, much more than the Generation of an Animal ? In one Word, some more positive Proof must be assigned, than that of their Motion in Liquids, for this Argument is at best but Equivocal, since the same appears in the Milt-Vessels of the *Calamary*, which is unquestionably a mere Machine; nor will the Continuance of this Motion observed in any one of them, which possibly may exceed that of the Milt-Vessel according to the Space they have to run through, before they reach the Point of Impregnation in the Uterus, add any Force to the Argument, unless the Excess be very great; since it must all depend upon the Nature of the Machine, as well as many other Circumstances, with which we are entirely unacquainted.

CHAP. VIII.

Of EELS in blighted Wheat.

SMUT in Wheat is a Disease, by which the interior farinaceous Substance is destroyed, and a foreign Matter introduced, which discolours and blackens the Grain, at least on the Out-side. This Matter is either a black Dust extremely fine, but affording no Uniformity in the Shape of its several Particles, when viewed in the Microscope; or it is a white Substance, consisting wholly of longitudinal Fibres bundled up together, without the least signs of Life or Motion, if exposed upon the Object-Glass of the Microscope, just as they are extracted out of the Grain, without applying Water.

Plate V.
Fig. 6. 7.

When I first discovered them, I had no other Design in the Application of Water, than to develope the Bundle, that I might view the supposed Fibres, as they appeared to me to be, with more Advantage. I was consequently much surprized to see them, as it were, instantly

Of EELS in blighted Wheat.

take Life, move regularly, not with a progreffive, but twifting Motion at each End, and continue fo to do till the next Morning.

This Obfervation has been repeated feveral Times with this Difference only, that tho' at firft, when the Grains were fresh-gathered and foft, nothing more was neceffary, than to extract the Animalcules out of them, and apply Water; yet after they had been kept fome time, it was requifite firft to macerate the Grains in Water for fome Hours, before the Contents were extracted, which upon the Application of Water, as above, would gradually come to Life, of which few or none give any Signs, unlefs they are fo macerated before-hand.

How thefe Eels fubfift (for fo I call them upon account of their being an aquatick Animalcule not unlike the Fresh-Water Eel, with this Difference, that in them both Extremities are alike without any Appearance of Mouth or Head) whence they come, what they convert into,
if

if they suffer any Change, or how they propagate, I could never learn; all that I know is, that I have observed Numbers of them for seven or eight Weeks, which have continued alive only by supplying them with fresh Water ; others I have frequently left dry for some Days, after the Water had evaporated, and revived as often by allowing them a fresh Supply; and in general, which to me is a Matter of great Surprise, I have had by me now for these two Years, and more, Grains of this blighted Wheat preserved dry in a Box, which, tho' after they had been gathered in *England* had first passed a Summer there, and since that Time a second in the hot dry Climate of *Portugal*, yet afford the same Phænomena to this Day without any Manner of Variation.

The surprising Nature of this Animalcule, however inexplicable in itself, confirms and enables us to account for the Observation of several Farmers, which Mr. *Bradley* takes Notice of, that Blight in Wheat, among

Of EELS in blighted Wheat.

other Causes assigned by him, is frequently occasioned by the sowing of Seed intermixed with blighted Grains. For if we suppose, that these Animals meet with in the Ground sufficient Moisture to give them Life, if I may so term it, either they, or their Eggs may easily communicate, and rise with the young Corn. Accordingly Mr. *Bradley* prescribes a strong Brine to be made with a Dissolution of Allum in it, which if the Seed be steeped in it for the Space of thirty Hours, after it has been washed in Fresh-Water, and the Grains that swim at the Top, as the blighted Corn will, carefully skimmed off, will effectually preserve the new Crop from any Infection of that kind : Which Effect in all Probability may be owing to the saline Particles penetrating the Grains, and destroying the Animalcules, wherever they find the least Remains of them. He asserts at the same time, that if ever this Maceration has proved ineffectual, it is to be attributed either to the want of Strength in the Brine, or an Allowance of competent Time for the Steeping

Steeping of the Grains. In effect, I myself have macerated these blighted Grains in a strong Brine, as prescribed, and extracted the Animalcules alive, at the end of twelve or fifteen Hours, but after thirty or more could discover no signs of Life or Motion in them. The Area of the Microscope containing these Animalcules, as it appears through the third Magnifier of the common double reflecting Microscopes, and a single one as seen through the greatest Magnifier, you have represented Plate V. *Fig. 6. 7.*



CHAP. IX.

*A small Insect of the Scarabee Kind
found upon the Narcissus.*

Plate V.

Fig. 8. 9.

10. 11.

12. 13.

14. 15.

MR. *Reaumur* observes very well, in the fifth Memoir of his natural History of Insects, that the Dust found upon the Wings of the papilionaceous Kind, is properly to be called, and has in Effect more of the Nature of Scales, than Feathers. Thus tho' they contribute to strengthen the Wing, and in that sense are of service to the Butterfly, yet they seem as much designed for Ornament as for any real Use. A small Insect of the *Scarabee* Kind, which I found feeding upon the *Farina fœcundans* of the *Narcissus*, may serve to confirm this Observation, and in this Particular is, I believe, singular in its Kind, having never observed it in any of that Sort before. The whole outward Surface of the Body of this Insect was adorned and covered with Scales, as delineated Plate V. Fig. 13. 14. 15. but those on the *Thecæ* of its Wings were of different Colours, and

and so disposed, as to cause them to appear spotted and variegated throughout the whole Surface. The Insect is so very small, as appears from its natural Size represented Plate V. *Fig.* 8. that I should have overlooked this Particular, had I not accidentally observed, that upon handling it changed its Colour, and lost its Spots. The Scales are the smallest of the Kind I have ever seen, and were drawn from the greatest Magnifier of the common double reflecting Microscopes, being scarce visible through any other, tho' the Insect itself was taken from one equivalent only to the Third. Plate V. *Fig.* 9. 10. 11. 12. I have given a double Representation of it, each with its Reverse, one in its natural Attitude, the other with the Head erect. Perhaps the small Spots, that appear upon many Insects of this, and some other Sorts, if examined, may be found owing to a Disposition of Scales of the same Nature.

CHAP. X.

The Eggs of the THORN-BACK.

Plate V.
Fig. 16.

THIS Fish, by what we may deduce from an Observation of its Eggs, differs in the Propagation of its Species from most other Fish. For whereas the generality of them are known to assemble together in Multitudes where the Females deposit their Spawn, which instantly is impregnated by the Milt of the Male without Copulation, the Eggs of this Fish on the contrary are in all Probability impregnated before Deposition. The outward Shell is thin, of a dark Brown, something transparent, extreamly tough, and shaped as represented Plate V. Fig. 16. The Contents are, as in all other Eggs, first the Albumina investing the Yolk; next the Yolk itself, which differs in nothing from that of others, but Colour, this being White, as those are Yellow, yet when hardened in hot Water, it appears, as they do, to consist of Globules, which are supposed to be Vesiculæ containing the

the Nourishment of the included Fœtus. The whole inclosed Substance has its *Membrana communis* like all other Eggs, which lines the whole Cavity of the Shell; the Albumina also, and Vitellus or Yolk, have their separate Involucra, or Membranes. This Yolk however is not suspended by its Poles, as that of other Eggs are, the Chalazæ not being necessary, I suppose, in an Egg of this Shape. The Cicatricula also is extreamly plain even to the naked Eye, and appears rayed something like the transverse Section of a Lemon, which shews that these Eggs are fecundified before Deposition. The Description of them, which I have given here, as well as Delineation, Plate V. *Fig. 16.* were taken from Eggs immediately extracted out of the Ovary, or Uterus of the Female Thorn-Back.

CHAP. XI.

Of the BARNACLE.

I Have already taken Notice of this Sea-Production, and given something of a general Description of it, in the Introduction to this Essay. I then proposed, and since the Time of Writing it have had Opportunities of examining this Animal with more Accuracy, so far at least as to enable me to give an exacter Description of it with certain Drawings from the Microscope, which I thought necessary to illustrate it, tho' I have not been able to clear up the Manner of its Propagation in a Way as satisfactory as I could desire. For altho' upon opening the Shells, which tip the long cylindrical Stem of the *Barnacle*, I found in several Subjects a blue Excrecence on each Side just below the Groupe of Horns, which, upon Examination in the Microscope, appeared to be a Membrane replete with small blue Globules of an uniform oval Shape, bearing a Resemblance of Spawn; yet as this Appearance, without the

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Concurrence of some other additional Observations requisite upon this Occasion, amounts to no more than a probable Argument, I cannot certainly pronounce, whether their adhesion in Clusters, and intimate Conjunction by the Roots of their Stems, be owing to any Analogy they may bear in Propagation to the *Polype*, or to the original Contiguity of the Spawn in its Deposition, which as the Animal by its Nature seems fixed to the Place of its Nativity, continues to adhere together in its Increase by the same Principle, which fixes it to the Ship or Rock from whence it seems to spring.

We may distinguish in this Sea-production, as it appears to the naked Eye, three remarkable Particulars; the black cylindrical Stem, by the Basis of which it adheres to the Ship or Rock upon which it is found; the Shell, that tips the Stem, and the Fish itself inclosed in the Shell. The Stem is hollow throughout its whole Length, yet so that the interior Vacuity is of no great Diameter in Proportion to the outward Circum-

Plate VI.
Fig. 1.

Circumference, as the Substance that constitutes it is of a considerable Thickness, composed of several Membranes inclosing each other, which consist of longitudinal Fibres, capable, while the Animal is alive, of being extended to near twice its natural Length, and when dry contracts, hardens, and is rough like Shagreen. I imagined at first this to be the Case containing the Body of the Fish, but upon Examination find, that the Shell, which tips the Extremity of it, contains the whole Fish, without any sensible Opening into the hollow cylindrical Stem, or permitting the Animal to have any apparent Communication with it; and it is upon this Account that I term it a Stem, and not Part of the Case, as I formerly supposed it to be.

Plate VI.

Fig. 2. a.

The Shell containing the Fish is to appearance bivalve, tho' upon an accurate Inspection it appears that each Side of it consists of two Parts, adhering together by a thin Membrane lining the concave Surface, which consequently goes between each Division, and joins them to each other

other in such a Manner, that the Animal enjoys the Advantage of drawing in fresh Water and Food, not by causing the two Sides to recede, as Oysters and Muscles do, (which is prevented by a curve concave Hinge, into which their Edges are inserted, extending to more than half their Circumference) but by forming Angles at each Division, in such a Manner, as to give the Aperture nearly the Figure of a Rhomboid. Thus whatever is attracted by the play of its Horns, is easily retained within the Cavity which the Valves form ; and as when the Animal is undisturbed, the Shell is constantly open, it enjoys a continual Supply of fresh Water, which it alternately sucks in, and ejects. This Action appears when the rest of the Apparatus is at Rest, by the Play of two corresponding Antennæ, resembling those of some Insects, which nearly keep Time with the Motion of the Gills in other Fish.

Plate VI.
Fig. 3.

Fig. 1. a.

The Head of the Fish is furnished with an Apparatus of Horns
H to

Plate VI.
Fig. 1.

to the Number of twenty or more, gradually lessening in their Length, and forming irregular Curves inclosing one another. By the Motion of these Horns, which may be exerted in such a Manner, as to play either within or without the Cavity of the Shell, it forms a Current in the Water, which brings with it the Prey it feeds upon. In effect, I have sometimes found upon exposing the whole Groupe of Horns together with the Head of the Fish in the Microscope, the better to observe their Disposition, two sort of Animalcules, not bigger than a Grain of Sand, the one resembling a Crab, the other a *Pulex aquaticus*, entangled in the long Hairs which fringe the Concave of each Horn.

Plate VI.
Fig. 6.

Every Horn consists of several Joints, and each Joint is furnished on the concave Side of the Horn with a Brush of long Hairs. The Horns, when exposed in the Microscope, appear something opake; but may be rendered transparent by extracting out of the interior Cavity a Bundle of longitudinal Fibres, as the
Micro-

Microscope shews them to be, which runs the whole Length of each Horn; in which Particular they seem to resemble those of the *Shrimp*, *Cray-Fish*, and *Lobster*.

In the midst of this Groupe of Plate VI.
Horns, just above the Mouth, is a hol- Fig. 5.
low Trunk, consisting of a jointed hairy Tube, which incloses a long round Tongue, if I may so term it, resembling that of the *Wood-Pecker*, and may, as I imagine, be occasionally darted out of its Sheath at the Aperture, or retracted; and thus it is represented in the Figure taken from the Object itself in the Microscope immediately after Separation from the Head of the living *Barnacle*; upon which occasion I could perceive the Extremity of the Tongue often emerge at the Aperture, and return into its Sheath by a convulsive Motion, which it retained after Avulsion for a considerable Time.

The Mouth of this Animal is singular in its Kind, consisting of six Plate VI.
Laminæ, which go off with a Bend, Fig. 1. a.
indented like a Saw on the convex
H 2 Edge,

Plate VI.
Fig. 4.

Edge, and by their circular Disposition, being fixed at that Extremity, where the Remains of the Sinews that give them Motion appear in the Figure, are so ranged, that the Teeth in the alternate Elevation and Depression of each Plate act in Correspondence against whatever intervenes. The Plates are gathered together in such a Manner, that to the naked Eye they form an Aperture not unlike the Mouth of a contracted Purse, and thus by their mutual Concurrence, armed as they are, effectually secure the Prey from escaping. A View of one of the six Plates, which I have given from the third Magnifier, will convey a better Idea of what I would say, than I can possibly express in Words, to which I refer the Reader.

Plate VI.
Fig. 4.

The Body of the Fish hath nothing remarkable in it, that falls within the reach of my Enquiry; I have consequently nothing to add concerning it, but that it nearly resembles in Shape the Body of a very small Oyster.

There

There is yet another Species of *Barnacle* of a smaller Sort, to be found adhering also to Ships and Rocks, which differs from those of the larger Kind chiefly in this Particular, that the Shell immediately inclosing the Fish, together with the Stem upon which it is fixed, is lodged within another univalve Shell, in Shape a truncated Cone, adhering to the Ship as that of the *Limpet* does, and may in Effect be easily mistaken for a *Limpet*. The Stem however is tenderer, and much shorter in Proportion to the Size of the Fish, than that of the larger Sort, just of a sufficient Length to enable the Animal to exert its Apparatus of Horns out of the Aperture of the univalve Shell. The Trunk of this Animal I have caused to be delineated, as well as that of the other Sort, to express the Nature of both, in which they differ something from each other, the Trunk of the lesser *Barnacle* inclosing a Tongue in Proportion much longer than that of the larger Sort, and, when sheathed, gathered into small Spires.

Plate VI.
Fig. 7.

Plate VI.
Fig. b. 7.

Plate VI.
Fig. 7. a.

Plate VI.
Fig. 7. c.

Plate VI.
Fig. 8.

I have nothing more to add concerning these Animals, but to repeat the Observation which I have already made in the Introduction to this Essay, relating to the Analogy there seems to be betwixt these Sea-Productions, and Mr. *Lewenboeck's* microscopical Wheel-Animals, of which he has also discovered two Sorts; one that is found in leaden Gutters, which, when disturbed, retract the Wheel-work within their Body; and another upon Duck-weed, which not only withdraw their Wheel-work within their Bodies, but their Bodies also within a Sheath. I need not repeat the Particulars, which I have already advanced in my Introduction, by which I have endeavoured to make it probable, that this seeming Wheel-work is in Effect nothing more, than the Play of a Groupe of Horns: I am however persuaded, that if what I have taken Notice of already in the foregoing Descriptions be duly considered, and a due Allowance made for the Minuteness of Mr. *Lewenboeck's* Animalcules, of which our best Magnifiers give but an imperfect View, most of the ob-
served

served Phænomena may be well explained by the Analogy the Wheel-animals seem to bear to the two Sorts of *Barnacles* described in this Chapter, but much more so, if they be compared with Mr. *Trembley's Polypes à pannache*, from which they seem to differ in nothing more than Size. Nor can the Appearances of a Wheel revolving round its Axis be explained otherwise, than by supposing it real, which seems inconsistent with the Nature of Animal Oeconomy, or seeming only by the Play of a Groupe of Horns, since it is impossible for it really to revolve, unless, as I observed before, it be entirely detached ; in which Case, neither can the Animal command its Motion, nor can its Increase or Subsistence, as Part of an Animal, be well understood ; the circular Motion which a Man's Arm is capable of, being so very different from the Revolution of a Wheel round its Axis, that it scarce seems to bear even a distant Analogy to the seeming Wheel-work of these Animals.

CHAP. XII.

An Examination of the supposed Embryoes of SOLES, found upon a Species of Shrimp.

IT is generally believed upon the Coasts of *England* and *France*, that *Soles* are produced by means of a certain Species of *Shrimp*, or *Prawn*, which differs from the ordinary Sort, being of a lighter Colour, and much more transparent. I find the same Opinion current among the Fishermen in *Portugal*, where this Kind is known by the Name of the *Sole-bearing Shrimp*. 'Twould be strange, that this Sentiment should be so general among Persons, who are not much exposed to the Sallies of a too lively Imagination, and yet be false : For I can scarce imagine, they could ever have so universally fallen into this Opinion, upon Coasts so very distant, without some more pregnant and sensible Proof, than the mere exterior Shape of the Object, which to the Naked-Eye at best affords

affords but an imperfect Resemblance of a *Sole*. In effect, Mr. *Deslandes*, as it appears by the Memoirs of the *Royal Academy of Sciences*, 1722, took a considerable Quantity of these *Shrimps*, and preserved them alive in a Vessel of Sea-Water, where after the Space of twelve or thirteen Days he found eight or ten little *Soles*. He repeated the Experiment several Times, always with the same Success. After this he kept alive in Sea-Water *Soles* alone without any *Shrimps* for a considerable Time, and tho' they Spawned in the Vessel, yet the Spawn came to nothing; from whence he concludes, that these Objects found upon *Shrimps* are really the Embryoes of *Soles*, as they appeared to him to be in the Microscope, and that the Spawn of the *Sole* requires the Assistance of the *Shrimp* to hatch it. Mr. *Deslandes* might have placed this Consequence in a much better Light, and excluded effectually all Objections, had he taken the Precaution to have counted the Number of the supposed Embryoes upon a smaller Quantity of *Shrimps*, and compared the Increase
of

of living *Soles* with the Decrease of the supposed Embryoes, in case he had observed them to drop off after a certain Time; more particularly had he set apart a certain Number for daily Observation in the Microscope, which would have enabled him, if his Opinion is true, to have given us an Account of their gradual Progress, till the Time of Hatching. For it is not impossible that in a Quantity of Sea-Water some very few small *Soles* might have been contained at first unperceived. For my own Part, I have been prevented from making these Observations by being obliged to remove to some Distance from the Sea, soon after I had examined the Object taken from some living *Shrimps*, in the Microscope; the Description however which I shall give of it, together with a Singularity in it that had escaped Mr. *Deslandes*, will, I believe, be a sufficient Encouragement to induce those Gentlemen, who may be situated near the Sea, to observe it with more Accuracy; and this is all I am able to advance upon the Subject at present, which is in reality

ality very far from being sufficient to determine what it really is.

On the left-side of the *Shrimp*, just below the Head, a circular Portion of the Shell, about one fourth of an Inch in Diameter, rises to a convex Surface, and incloses within within it a plano-concave Excrecence, the Concave of which is raised to a Convex by the Insertion of a Quantity of Spawn, protruding at one Extremity an expanded Tail, at the other a bony Substance, somewhat resembling the Head and Tail of a small Sole. The Body also, when the exterior concave Surface is cleared of the Spawn, which fills the Cavity, appears to be distinguished throughout its whole Length by a seemingly articulated Line, with others equidistant departing from it at acute Angles, as the small Bones are known to go off from the Backbone in the generality of Fish; the intermediate Spaces are accordingly filled up with a light-coloured fishy Substance. But what is still more remarkable, is, that if a small Portion of the circular Ledge, that forms the Cavity
on

on the Back of the Embryo *Sole*, be separated from the Body, it draws out with it, and exhibits in the Microscope distinctly the small Bones, that strengthen the Fins, and are known to invest the whole Circumference of a *Sole*, appearing not unlike a Forehead Comb. It must be owned however, that the other Appearances in the Object, if we except this last, are at best but indistinct, as first Lineaments usually are, agreeable to their imperfect State, which those may say who believe it to be an Embryo *Sole*.

The Spawn that may be extracted out of the Cavity, whatever is the Reason of it, whether more advanced in one than another, in some of the *Shrimps* is of a Yellow Cast, in others of a dark Brown : When seen in the Microscope, it appears to consist of round Globules much like the Spawn of other Fish, with this Difference only, that the Embryo is seen within the transparent exterior Shell or Case much plainer, appearing like a small Grub doubled within its Invelop.

But

But the greatest Singularity, which has escaped Mr. *Deslandes*, is a small Insect about the Size of a Grain of coarse Sand, with sixteen Legs, two small Antennæ, two prominent Eyes something like those of the *Shrimp*, and a Body articulated like that of the *Wood-louse*, fastened (as I imagined, tho' I am not sure of it) by a small Ligament to the Surface of the Tail ; which, if it be really so, as it appeared to me to be upon separating the Animal from the Surface of the Tail of the *Sole*, must necessarily convey Nourishment to it ; for after viewing it in all possible Situations, I could discover no Appearance of any Mouth, by which the Creature might feed itself. The most surprising Circumstance, however, is, that this Animalcule is the only one of its Kind upon the Embryo *Sole* ; in the Examination of which Particular all imaginable Precautions, that the most exact Enquiry can demand, were taken to prevent any Mistake, and not one of these supposed Embryo *Soles* was without it. The Insect is in Size and every other Respect the same
in

in all; and what is still more remarkable, even its Situation too, which is not in a Line parallel to the supposed Back-bone of the *Sole*, but inclining, and forming an acute Angle with it; nor does it ever, as I could observe, vary its Posture any otherwise, than by a very slow waving Motion of the Tail, scarce perceptible by an ordinary Magnifier, tho' if separated from the supposed *Sole*, and immediately placed upon the concave Object-Glass of the Microscope with a Drop or two of Sea-Water, without which it soon perishes, it moves its Antennæ and Legs very vigorously, appearing in every Respect to be an Animal arrived at its utmost Perfection.

What therefore this Insect is, what the supposed Embryo *Sole*, and whence that Spawn comes which is lodged in the Cavity of its Back, cannot possibly in my Opinion be determined by any of the foregoing Circumstances, till some more exact Observations concur to set the Matter in a clearer Light, for which all imaginable Care, and constant Attendance

dance, as well as Situation near the Sea is necessary. For my own Part, if I had not Mr. *Deslandes's* Authority, the common Notion of Fishermen upon Coasts very distant from each other, the Shape and Structure of the supposed Embryo *Sole*, and the current Opinion that all *Shrimps* (unless this Species may be excepted, which I have not heard of) carry their Spawn between their Legs, as *Lobsters* and *Cray-fish* do, till they are hatched, together with the additional Circumstance of the Animalcule being in Size and every other Respect invariably the same in all, to encounter with, I should be inclined to think (from a microscopical View of the Spawn inclosed in the Cavity, the Animalcule and its Situation, as well as the Observation of its being Single, and fixed to the Place by a Ligament, or whatever else it may be in the Nature of a *funiculus umbilicalis* affording it Nourishment,) that this Animalcule is a *Shrimp* in its first State, which possibly undergoes as many Changes as most terrestrial Insects do, before it arrives to its
last

last Stage ; that the supposed Embryo *Sole* is no more than a Matrix, and that there is a continual Succession of them supplied from the Provision of Spawn, each Globule of which may hatch gradually, as the Animalcules drop off. In Effect, the Spawn is known by an ingenious Person of my Acquaintance, who, has frequently observed it, to diminish insensibly, and the Cavity to be filled up to a convex Surface by some other adventitious Matter, which in the Opinion that what I call the Matrix is an *Embryo-Sole*, he supposed had been exhausted in the Nourishment and Increase of it, till the Discovery of the Animalcules, which put him to a stand, as well as myself. After all, both Opinions may have something of Truth in them, and the Embryo *Sole*, if it be so, perform the same good Offices to the Progeny of the *Shrimp*, as the Mother *Shrimp* does to it. But however that Matter be, the Subject, in my Opinion, is well worth Observation, and deserves to be cleared up.

I cannot conclude this Chapter without taking Notice of one Particular in Mr. *Deslandes's* Account, which is, that what he calls the Embryo *Sole* is contained, according to him, in several small Bladders rising betwixt the Legs, and strongly agglutinated to the Stomach of the *Shrimp*. Now, tho' I cannot positively say, that I have met with the same Object, or the same Species of *Shrimp*, that he has, yet this I am sure of, that in Numbers of those I observed, the Generality at least, if not all, had not above one Excrecence of this Kind on the left-side just below the Head, and that more in the Nature of an Excoriation of the outward Shell of the *Shrimp*, than a Bladder, as he describes it; I say the Generality, because I will not be positive, that I have not met with some few, which had an Excrecence on both sides, exactly opposite to each other. It is what I am inclined to believe, tho' at that Time I took so little Notice of it, that it has in a great Measure escaped my Memory.

CH A P. XIII.

Of the Tongue of the LIZARD.

THIS little Animal is extreamly common in *Portugal*, I suppose it may be so in all Hot Countries, where they are of singular Service in destroying great Numbers of Flies, and other troublesome Insects, which without Enemies of this Nature would increase beyond Measure. As to its Shape, and other Circumstances of that Nature, which is not unlike that of the *Newt* in our own Country, 'tis so well known, that I need not insist upon it, any farther than to observe, that it is covered all over with Scales, which are an agreeable Object in the Microscope. It is oviparous, and deposits its Eggs in old Walls, whither they themselves retire in the Winter Months, leaving them to be hatched by the Heat of the Air, which alone is sufficient. The Circumstance of their having sometimes two Tails has been taken Notice of
by

by Mr. *Marchant* in the *Memoirs* of the *Royal Academy* at *Paris*, *Anno* 1718. and before him by *Pliny* and several others. This is what is also sometimes seen in *Portugal*; but as nothing is more common among Boys in that Country, than to catch and torture these Animals all imaginable Ways their little Malice can invent, I believe it may be owing originally to their Tails having been cut longitudinally by some such Means, and so each part rounding itself has become an entire Tail. As to this Part repairing itself, when either it, or any Portion of it has been lost by any Accident, nothing is more common, I have myself seen repeated Instances of it without Number. For as it is a Loss they are exposed to every Day even in their own mutual Engagements among themselves, by the Ease wherewith the little bony *Vertebræ*, of which it consists, are separated from one another, nothing is more usual than to find them of all Lengths in different Subjects; tho' Mr. *Marchant* informs us, that an Experiment of this Nature did not succeed with

I 2 him.

Of the Tongue of the LIZARD.

him, for which he professes he can assign no Reason. This new Tail, according to him, is a kind of Gristle, and does not consist of cartilaginous *Vertebræ*, as the old one does.

I take Notice of this Particular more willingly, tho' otherwise impertinent to my principal Design, which is the Description and Delineation of its Tongue, because it bears some Analogy to the reproductive quality of the *Polype*, which employed and entertained the Curious so agreeably some little Time ago, and is, I believe the only Instance of its Kind assignable in any Land-Animal.

The Tongue of this Animal is forked, as may be seen in the Figure, which it vibrates with exceeding Velocity, and is admirably contrived for its Purpose according to the Nature of the Prey it feeds upon. In the Microscope it appears as delineated, indented like a Saw on the Edges, and furrowed all over the convex Surface of it, and this, no doubt of it, the more effectually to
secure

secure its Prey, which being winged might otherwise easily escape from it. In short, 'tis a Subject that requires little Explanation, the simple Delineation of it expresses it better than Words can, and it is to the Figure that I refer the Reader, with Notice only, that it is drawn from a Tongue pressed and dried between two Glass Planes, to render it more transparent, and oblige the Teeth to start up, which otherwise lie close to the Edges, at least when the *Lizard* is dead, tho' in all Probability when the Animal is alive they may be exerted by it, or depressed at Pleasure. This Method of preparing the Object for the Microscope has in some Measure erased the transverse Furrows, and left little more than their Shades, which I thought proper to advertise the Reader of, that he might have a better Conception of it in its natural State.



An Explanation of the Figures.

Plate I. *Fig. 1.* the *Calamary* with its Horns displayed, and Beak something more exerted, than it naturally is, for better Observation.

Fig. 2. One of its large Suckers.

Fig. 3. The cartilaginous Ring, which is inserted in the Membrane, that forms the Cavity of the Sucker.

Plate II. The same *Calamary* reversed, with its Case ripped open, to shew the Intestines.

C. The Duct, or Channel, thro' which the Ink passes, when ejected into the Water.

B. B. Two parallel cylindrical Cartilages, which prevent the two Sides of the Duct, or Channel from falling together.

A. The Ink-Bag, with its Contents.

E. E. The Spawn.

F. F. Two parallel Tubes, which in the Female perhaps may serve for depositing the Spawn, as in the Male they serve for ejecting the Milt-Vessels.

G. G. An Expansion of Vessels replete with a blackish Substance.

H. A Layer of Fat covering part of the Stomach, which lies under it.

I. A thin transparent Membrane.

K. K. The two Flaps of the ripped Case.

L. L. The two Fins.

Plate III. *Fig. 1.* The Tongue and Throat expanded for Observation, as it appears thro' the third Magnifier of the common double reflecting Microscope.

Fig. 2. Its natural Size.

Fig. 3. Its Shape when in the Fish.

Fig. 4. A Portion of the same Part in the *Cuttle-fish* delineated, to shew the Difference in Shape betwixt the Teeth of the *Calamary* and those of the *Cuttle-Fish*.

Fig. 5. The Beak, and Head of the *Calamary* extracted out of the corrugated Lip, which incloses it.

Fig. 6. A. A mature Milt-Vessel, as it appears thro' the third Magnifier of the reflecting Microscope, where consequently that part of the Apparatus which contains the Semen is represented Black, as being opaque, tho' in reality White.

Fig. 7. A. Its natural Size.

Fig. 8. A. Its Appearance, after it has operated.

Fig.

Fig. 9. A. An Instance of its breaking the Screw, without separating the Sucker from the Cup.

Fig. 10. B. An immature Milt-Vessel after Operation.

Plate IV. *Fig. 1. B.* The Consequence of cutting the lower Extremity of the outward Case.

Fig. 2. B. The Extremity cut off.

Fig. 3. B. The Consequence of cutting a small Slit in the Side of the outward Case.

Fig. 4. B. The Consequence of dividing the Case, and cutting off the Screw just below the Cup.

Fig. 5. B. The Upper-part of the Case which incloses the Screw, Sucker and Cup severed from the Lower.

Fig. 6. B. An Instance of the seeming Ligament below the Cup forcing its Way thro' the outward Case by the Smartness of the Stroke,
after

An Explanation of the Figures.

after it had been first reduced to an extream Tenuity, and then broke by the Action of the lower Part of the Apparatus, upon cutting off the Extremity of the outward Case.

Fig. 7. B. The Extremity of the Case, which had been severed.

Fig. 8. B. The Consequence of dividing the Milt-Vessel both above and below.

Fig. 9. B. The Head of the Case with the Screw, Sucker, and Cup, severed.

Fig. 10. B. The lower Extremity of the divided Case.

Plate V. *Fig. 1.* The Pistil, Stamina, with their Apices and Uterus, of the common white Lily.

Fig. 2. One of the Papillæ magnified, containing a Globule of Farina.

Fig. 3. A transverse Section of the Uterus of the same Flower magnified.

Fig.

Fig. 4. The Area of the Microscope containing several Globules of the Farina fecundans of Mallow in Action, as seen through the third Magnifier.

Fig. 5. A Globule of Farina in Action, as seen through the greatest Magnifier, taken also from the same Flower.

Fig. 6. The Area of the Microscope containing a Multitude of *Eels* extracted out of blighted Wheat, as seen through the third Magnifier.

Fig. 7. A single *Eel*, as it appears through the greatest Magnifier.

Fig. 8. A small Insect of the *Scarabee* Kind, described Chap. IX. according to its natural Size.

Fig. 9. 10. The same Insect and its Reverse with the Head erect, both magnified.

Fig.

Fig. 11. 12. The same Insect and its Reverse in its natural Attitude, magnified.

Fig. 13. 14. 15. Three of its Scales, as they appear through the greatest Magnifier.

Fig. 16. The Egg of the *Thorn-back* opened, a Portion of the outward Case being thrown aside, in order to observe the Contents: The Whole drawn as it appears to the naked Eye.



*An Explanation of the Figures of
the sixth Plate.*

PLate VI. *Fig. 1.* A *Barnacle* of the larger Kind laid open, with its Apparatus of Horns, Trunk, and Mouth extended: In which Figure *A* denotes its Mouth, *B* its Trunk.

Fig. 2. One of the Sides of the Shell thrown aside, that the Fish may appear ; in which the white oblique Stroak *A*, denotes the Division of the two Parts of which it is composed.

Fig. 3. The Hinge that joins the two Sides together. All these three Figures are drawn as they appear to the naked Eye.

Fig. 4. One of the six Plates, that compose the Mouth, magnified.

Fig. 5. Its Trunk magnified.

Fig. 6. One of its Horns magnified.

Fig.

Fig. 7. One of the smaller Species of the *Barnacle*. *A*, the univalve Shell; *B*, the interior Shell that tips the Stem emerging at the Aperture of the univalve Shell; *C*, its Apparatus of Horns exerted. All this as it appears to the naked Eye.

Fig. 8. Its Trunk magnified.

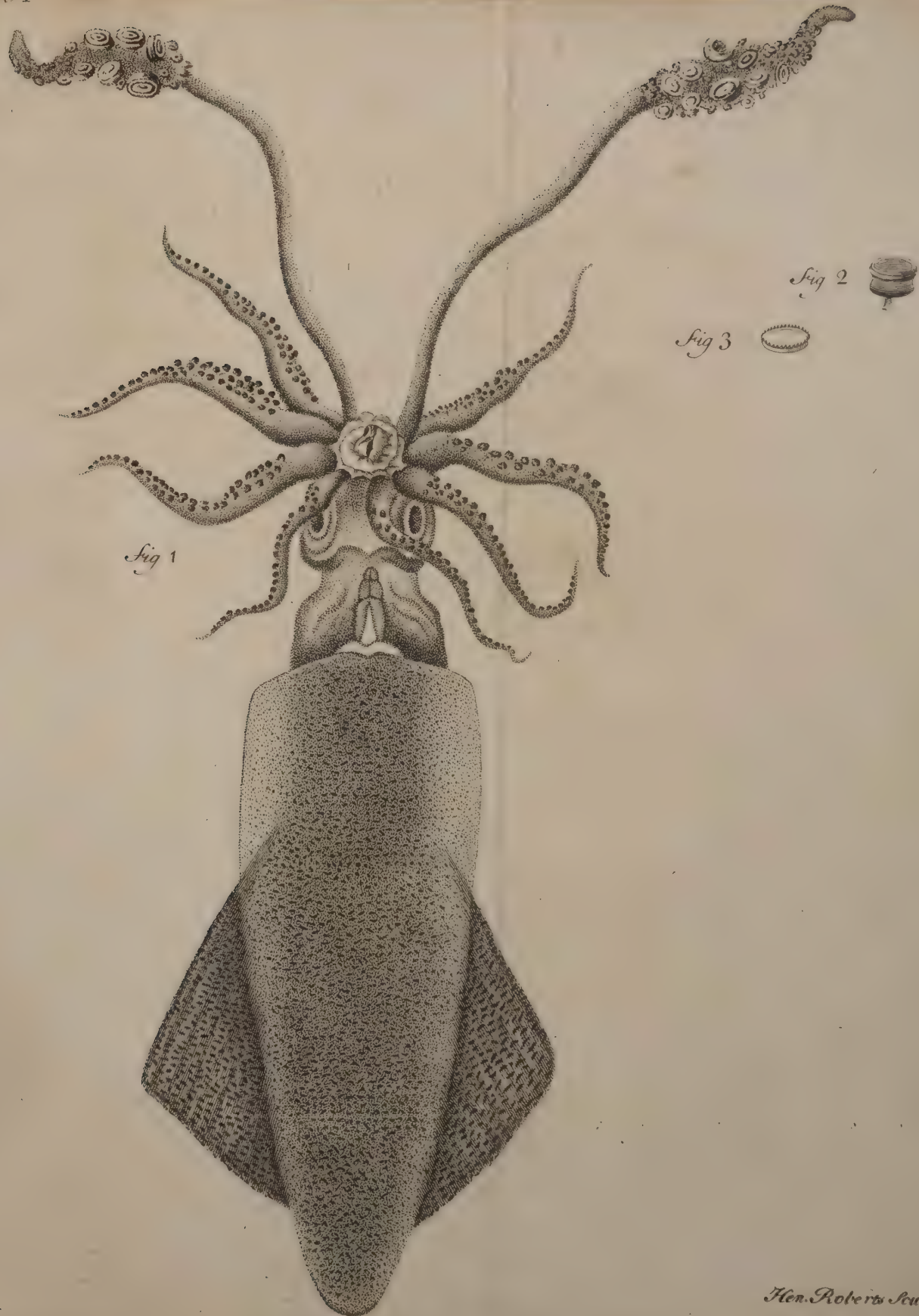
Fig. 9. The supposed *Embryo-Sole* according to its natural Size. *A*, the Animalcule on the Tail.

Fig. 10. The Spawn extracted out of the Cavity, and thrown aside to lay open the Lineaments of the Vertebrae of the Back-bone, &c. in the *Embryo-Sole*.

Fig. 11. The Animalcule magnified, with its Back obverted to Sight: The Eyes and Antennæ lie under.

Fig. 12. The Tongue of the *Lizard*.

F I N I S.





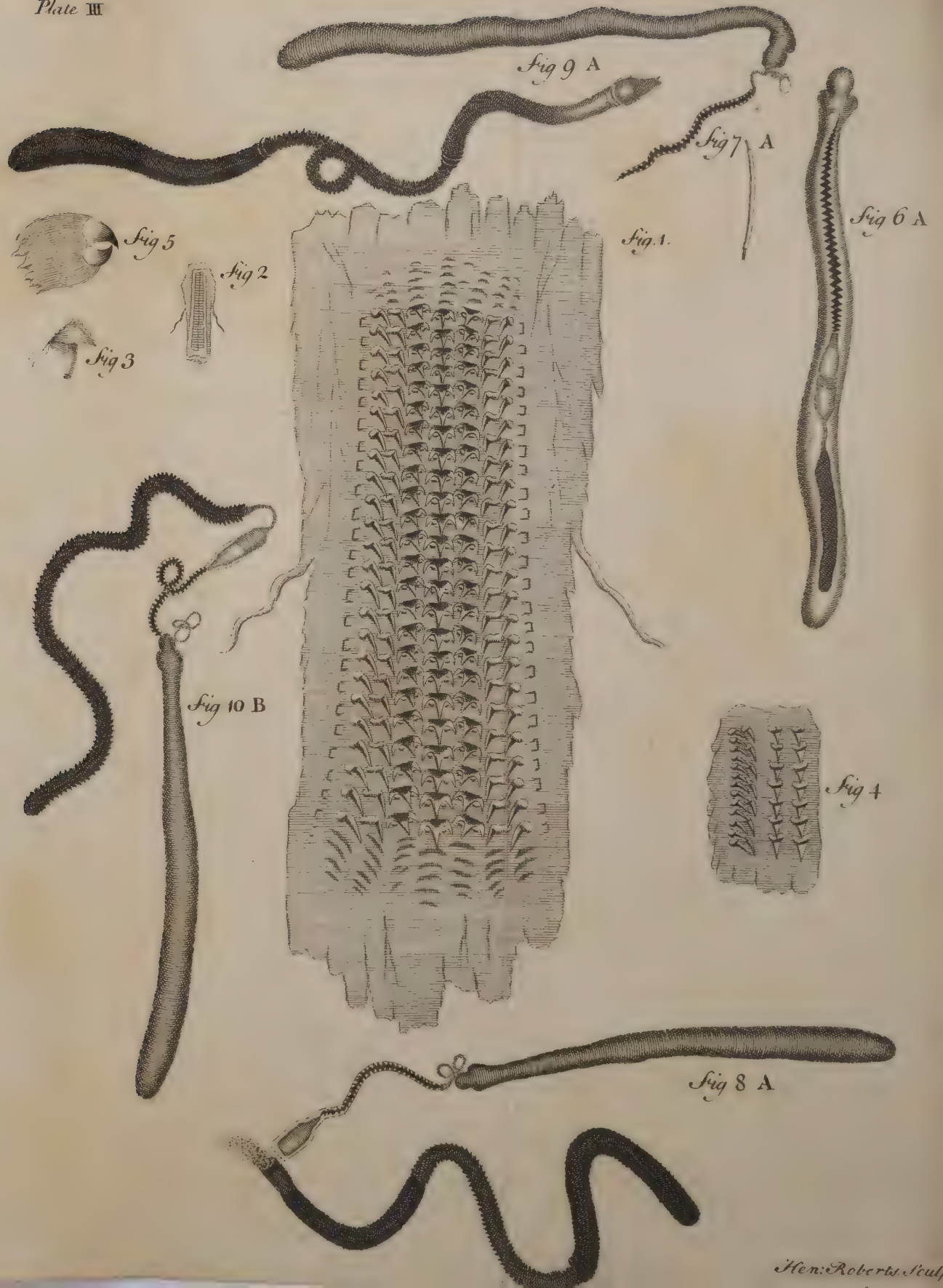
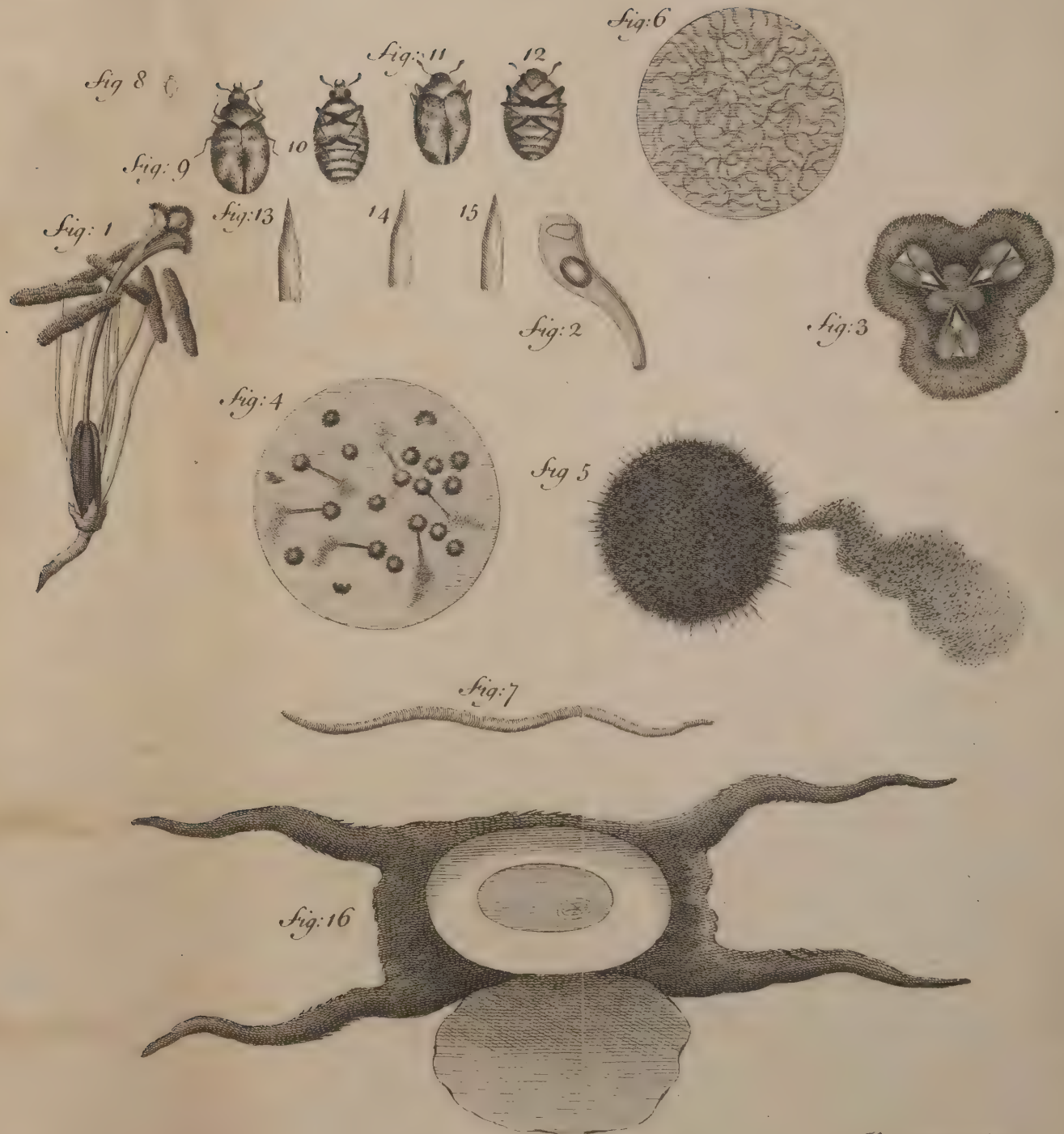


Plate IV.





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